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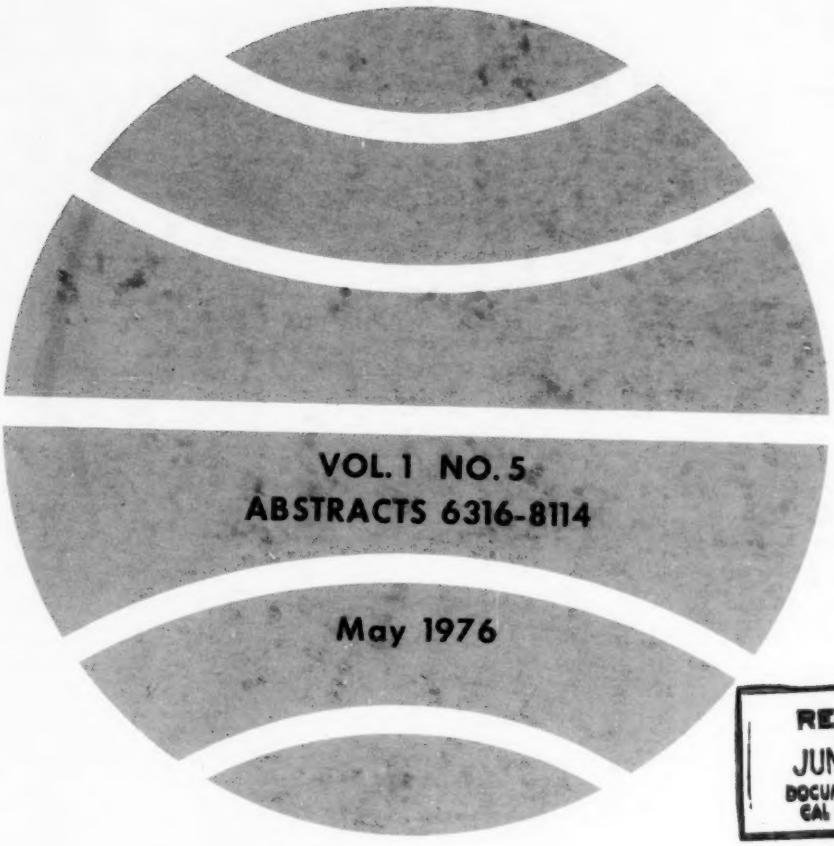

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SCOTT, C.D., See JOLLEY, R.L., 75:847
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See also COED PROCESS
SYNTHANE PROCESS
COAL GASIFICATION/BI-GAS PROCESS
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is indexed as:

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TEXTRON, INC., SYLMAR, CALIF. (USA). SPECTROLAB DIV.
Terrestrial photovoltaic power systems with sunlight concentration. Quarterly porgress report, July 1, 1974--September 30, 1974, 75:00737 (NSF-RA/N--74-129)
THERMO ELECTRON CORP., WALTHAM, MASS. (USA)
Advanced thermionic technology, FY1975. Progress report number 4, October 1974, 75:00821 (TE--4190-57-75)
TYCO LABS., INC., WALTHAM, MASS. (USA)
Continuous silicon solar cells. Third quarter progress report, July 1, 1974--September 30, 1974, 75:00742 (NSF-RA/N--74-139)
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ERDA ENERGY RESEARCH ABSTRACTS

COAL AND COAL PRODUCTS

6316 (ORNL-TM—5214) **Coal Technology Program progress report for November 1975.** (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 25p. Dep. NTIS $5.00.

This report, the sixteenth of a series, is a compendium of monthly progress reports for the ORNL research and development projects that are in support of the increased utilization of coal as a-sorce of clean energy. The projects reported include those for hydrocarbonization, solid-liquid separations, chemical research and development, engineering evaluations of nuclear process heat for coal conversion, engineering evaluations of the Hydrocarbonization and Synthoil processes. Two shakedown runs were completed in hydrocarbonization research. Five and 20 lb coal were pyrolyzed at ca. 1050°F under 5 atm N_2 pressure. It is hoped that H_2 will be introduced into the system in January. Batch settling tests showed that with 20% toluene settling was faster at low than at high temperatures. Additives have been found that in ppM concentrations give complete settling at very short residence times. The use of transmission electron microscopy to examine the microporosity of coals has continued. Work continues in the engineering evaluations of nuclear process heat for coal conversion. In the engineering evaluations work for Synthoil, design of the high-temperature shift section and analysis of unit reactor vessels were initiated. (auth)

PROCESSING

6317 (FE—1526-2) **Factors influencing an area's ability to absorb a large-scale commercial coal-processing complex. A case study of the Fort Union lignite region. Final report, September 1973—June 1975.** (Denver Research Inst., Colo. (USA)). Aug 1975. 292p. Dep. NTIS $9.25.

The introduction of a hypothetical large-scale, multiple-product coal-processing complex promises to have a major impact on a rural Western community, if located in a representative area in the Fort Union coal region. Each complex is seen as employing 3,000 workers and requiring a capital investment of $2.5 billion. Likely scenarios for development show a doubling or tripling of population in affected areas by 1990, and major increases in personal income. In analogous instances where large-scale developments have been superimposed on rural communities the impacts have included housing shortages, inadequate retail and professional services, and an inability on the part of local governments to finance needed capital outlays and operating expenditures. This has led to resident dissatisfaction and alienation, unsatisfactory living conditions, high-employee-turnover rates, and low labor productivity. With careful growth management, most of these negative impacts appear to be avoidable. This will mean strengthening existing institutions, affecting resource use and conservation, developing the local labor force, and accommodating and retaining the local population. External financial assistance will be necessary during the early years of the development period. (auth)

DESULFURIZATION AND PURIFICATION

6318 (FE—496-T6) **Development of a process for producing an ashless, low-sulfur fuel from coal. Volume IV. Product studies. Part 7. Effect of catalyst pore size on hydrodesulfurization of coal-derived liquids.** Sooter, M.C. (Oklahoma State Univ., Stillwater (USA)). May 1974. Contract E(49-18)-496. 222p. Dep. NTIS $7.60.

Thesis.

An experimental apparatus was constructed to perform hydrodesulfurization studies on coal-derived oils. The trickle flow reactor was constructed to achieve isothermal operation along the length of the catalyst bed. The equipment was capable of operating from 77 to 950°F, from 0 to 1800 psig, and from 0.05 to 15.0 volume hourly space times. Reducing the most frequent catalyst pore diameter from 33 to 25 A was found to have a detrimental effect on desulfurization as predicted from previous work on petroleum feeds. Pressure was determined to have an effect on desulfurization in the range of 500 to 1000 psig with a decreasing effect beyond 1000 psig. Temperature data were found to best fit a kinetic model developed by assuming desulfurization as a number of simultaneous first order reactions. Changing catalyst particle size and hydrogen rate caused no significant increase in desulfurization. (auth)

6319 (FE—496-T7) **Development of a process for producing an ashless, low-sulfur fuel from coal. Volume IV. Product studies. Part 6. Hydrodenitrogenation of a coal-derived liquid.** Satchell, D.P. (Oklahoma State Univ., Stillwater (USA)). May 1974. Contract E(49-18)-496. 205p. Dep. NTIS $7.60.

Thesis.

An experimental apparatus was constructed to perform hydrodenitrogenation studies by catalysis of ash-free coal-derived liquids. Catalyst deactivation was observed at a reactor operating temperature of 800°F and after a reduction in the reactor operating temperature. Data were correlated using a second order rate expression. Activation energies of 28,000, 32,700 Btu/lb. mole (+-3000 Btu/lb. mole) were found for Nalco 72-4710B, Nalcomo 474, and Nalco 72-4710A over the temperature range of 600 to 750°F. The activation energy for denitrogenation over Nalcomo 474 between 750 and 800°F was 12,300 (+-9300) Btu/lb. mole. The rate of denitrogenation was found to be proportional to the total reactor pressure between 650 and 700°F over the pressure range of 500 to 1500 psig. Changes in the hydrogen rate over the range of 1500 to 20,000 SCF/bbl had little effect on the rate of denitrogenation. The rate of denitrogenation was found to be independent of the size of the most frequent catalyst pore radius over the range of 25 to 33 angstroms. (auth)

6320 (FE—2011-1) **Catalysts for upgrading coal-derived liquids. Quarterly report, June 9, 1975—September 9, 1975.** Crynes, B.L. (Oklahoma State Univ., Stillwater (USA). School of Chemical Engineering). 17 Sep 1975. Contract E(49-18)-2011. 40p. Dep. NTIS $5.00.

Two catalysts were assessed for their ability to remove S and N from coal-derived liquids. Catalyst SIV-III (cobalt-molybdenum-on-alumina) proved to be relatively good for denitrogenation of a raw anthracene oil. Nalcomo 474 catalyst (cobalt-molybdenum-on-alumina) revealed excellent desulfurization but rather rapid loss in denitrogenation activity using an FMC oil at 800°F, 1500 psig. A catalyst life test unit has been designed; equipment has been ordered and construction is underway. A field ionization unit for the CEC 21-110B mass spectrometer has been constructed and is being made routinely operational. Results from separation and analysis of reactor products and feedstock reveal the increased complexity of composition resulting from hydrogenation—hydrogenolysis reactions. (auth)

6321 (FE—2028-1) **Kinetics and mechanism of desulfurization and denitrogenation of coal-derived liquids.** Katzer, J.R.; Gates, B.C.; Olson, J.H.; Kwart, H.; Stiles, A.B. (Delaware Univ., Newark (USA)). 30 Sep 1975. Contract E(49-18)-2028. 50p. Dep. NTIS $4.00.

The design of the high-pressure liquid-phase microreactor has been completed, and assembly of the reactor system is at least half completed. The analytical techniques available for the analysis of sulfur and nitrogen-containing compounds in multicomponent white oil have been thoroughly reviewed, and a satisfactory analysis scheme has been developed. The scheme is centered around high-temperature gas chromatography with a nitrogen-specific detector for analysis of nitrogen-containing organic compounds and a sulfur-specific detector for sulfur-containing compounds. Samples of deactivated catalyst from the Synthoil pilot plant reactor have been analyzed by scanning electron microscopy and electron microprobe. Catalyst near the front of the reactor is 50 to 70% covered with a crust of ferrous sulfide which appears to be responsible for activity reduction. Smaller amounts of Cu, Si, Al, Zn and Ti were also present. Catalyst samples from near the exit of the reactor are essentially free of ferrous sulfide but have an irregular crust of Si-Al ash which covers 20 to 40% of the surface. A 300-cc autoclave has been purchased and set up for the hydrodenitrogenation studies. A catalyst-oil injection system which allows the catalyst and the nitrogen-containing reactant to be injected into the white oil in the autoclave which is already at reaction conditions has been developed. This avoids the problems associated with the heat-up period. (auth)

6322 (MERC/RI—75/3) **Limestone to remove hydrogen sulfide from hot producer gas.** Abel, W.T.; Fisher, E.P. (Energy Research and Development Administration, Morgantown, W.Va. (USA). Morgantown Energy Research Center). Jan 1976. 28p. Dep. NTIS $4.00.

Under a cooperative agreement with the Environmental Protection Agency the Bureau of Mines tested two limestone materials for their ability to remove H_2S from hot producer gas (1,000 to 1,600°F). One limestone was an essentially pure $CaCO_3$ particulate, while the other was an Illinois dolomitic limestone. The behavior of these absorbents in a bench-scale apparatus, passing simulated producer gas upward through a fixed bed of limestone, is described and the effects of operating variables (absorbent temperature, bed depth, gas velocity, and steam concentration) are discussed. The pure limestone showed little absorption capacity for H_2S until heated above its calcination temperature. The effects of operating variables (bed temperature, bed depth, gas flow, and steam concentration) in 3 psig simulated producer gas were interacting as shown by a model equation. Highest absorption capacity was favored at conditions of high bed temperature, gas flow, and bed depth and by low steam concentration. The dolomite in half-calcinated condition showed limited absorption capacity at 1,100°F in 100 psig simulated producer gas, increasing to about 10 percent of the initial dolomite weight at 1,500°F then decreasing sharply at 1,550 and 1,600°F. Under comparable conditions of gas flow, steam concentration, and bed depth, but in 3 psig simulated producer gas, the limestone in fully calcined condition at 1,400 and 1,600°F showed an H_2S absorptive capacity of about 34 percent of the initial limestone weight. Had the limestone been tested in 100 psig simulated producer gas, bed temperatures above 1,550°F would have been required to maintain it in fully calcined condition. (auth)

GASIFICATION

6323 (ANL—75-77) **Gasification of chars produced under simulated in situ processing conditions. Quarterly report, July—September 1975.** Fischer, J.; Lo, R.; Nandi, S.; Young, J.; Jonke, A. (Argonne National Lab., Ill. (USA)). Dec 1975. Contract W-31-109-Eng-38. 7p. Dep. NTIS $4.50.

This effort, which is part of the Argonne National Laboratory energy program for ERDA, is being directed toward support studies for the national endeavor on in-situ coal gasification. This task involves the investigation of reaction-controlling variables and product distributions for the gasification of both coals and chars utilizing steam and oxygen. Included in this task is the investigation of the effects of using brackish water as the water supply. (auth)

6324 (CONF-740727—P2, pp Paper F.1, 33p.) **Methyl alcohol production by in situ coal gasification.** Pasternak, A. (Univ. of California, Livermore). 1974.

From Engineering foundation conference) methanol fuel; Henniker, New Hampshire, USA (8 Jul 1974).

In Methanol as an alternate fuel. Vol. II.

The transportation sector is almost completely dependent upon crude oil as the raw material source for fuel. The need to use this country's large coal deposits as the raw material source is discussed. Methyl alcohol can be produced from coal and used as a transportation fuel in internal combustion engines. The production route involves gasification of coal to carbon monoxide and hydrogen (synthesis gas) and high-pressure catalytic conversion of these gases to methyl alcohol. In situ gasification of coal may be a less expensive way to produce synthesis gas than mining coal and gasifying it in surface plants. In situ gasification may also have less environmental impact and may be capable of using deep coal seams that cannot be mined economically. A process for in situ gasification leading to methyl alcohol production is described, and the thermodynamics and costs of the process are outlined. Capital requirements are estimated to be $354 million for annual production of methyl alcohol with a fuel value of 81 trillion Btu's. The selling price is estimated to be $1.04 per million Btu's (5.9 cents per gallon). Adding distribution costs to these production costs, it is estimated that methyl alcohol could reach service station pumps at a price competitive with gasoline. (auth)

6325 (CONF-7509100—1) **Interpretation of chemical and physical measurements from an in situ coal gasification experiment.** Brandenburg, C.F.; Reed, R.P.; Boyd, R.M.; Northrop, D.A.; Jennings, J.W. (Energy Research and Development Administration, Laramie, Wyo. (USA). Laramie Energy Research Center; Sandia Labs., Albuquerque, N.Mex. (USA); Wyoming Univ., Laramie (USA)). 1975. 28p. Dep. NTIS $5.00.

From 50. annual meeting of the Society of Petroleum Engineers of AIME; Dallas, Texas, USA (28 Sep 1975).

A second underground coal gasification experiment is being conducted at the Laramie Energy Research Center's field site near Hanna, Wyoming. The results are presented from the first phase of this Hanna II experiment in which coal seam premeability was evaluated, pneumatic linking and linking via reverse combustion were studied, and a sustained gasification process was maintained between the two linked vertical wells. Extensive in-situ and surface process instrumentation have provided considerable information on the chemical and physical mechanisms involved in underground coal gasification. Air injection alone did not increase permeability to levels that would allow sustained gasification. Reverse combustion linking was determined to be a local, relatively low-temperature process that advanced at a 5 ft/day rate and produced a high permeability carbonized path. Subsequent gasification was completed over a 38-day period. Overall, injection of 1.9 mm scf/day of air yielded 2.7 mm scf/day of gas with a heating value of 152 Btu/scf. Material balance calculations indicate that 1688 tons of coal in place were utilized. Specific discussion of reaction front configurations and interpretation of in-situ thermometry are included. (auth)

6326 (FE—0479-1) **Coal processing by electrofluidics. Final report.** Pulsifer, A.H.; Wheelock, T.D. (Iowa State Univ. of Science and Technology, Ames (USA). Engineering Research Inst.). Dec 1975. Contract E(49-18)-479. 156p. Dep. NTIS $7.60.

A process for producing a hydrogen-rich synthesis gas by reacting steam and coal char in an electrofluid reactor has been under development at Iowa State University for several years. Experimental data collected in a bench-scale reactor with top-to-bottom current flow are summarized in the report along with information about bed and contact resistances. Also, results of a study of the kinetics of the coal char-steam reaction in a fixed bed and data from a preliminary investigation of the gasification of coal in alkaline solutions are reported. The electrofluid reactor with top-to-bottom current flow operated well and no electrode overheating or slagging was observed. High rates of gasification were achieved at 1300°F with lignite and coal chars mixed with several potential catalysts. In a study of the resistance of the system, it was found that the contact resistance at the electrode surface could be a major component of the total interelectrode resistance. The electrode material used had the greatest effect interelectrode resistance. The electrode material used had the greatest effect on the magnitude of the contact resistance. Also, the bed resistance was observed to decrease as the temperature of the reactor was increased. Experiments where coal and coal char were gasified in aqueous solutions of several alkalis showed that this method of gasification gave relatively high rates of reaction at moderate temperatures. Hydrogen was the primary component of the product gas when the process was conducted at atmospheric pressure. (auth)

6327 (FE—1207-5) **Gas generator research and development CI-GAS process. Quarterly report, July—September 1975.** (Bituminous Coal Research, Inc., Monroeville, Pa. (USA)). 24 Oct 1975. Contract E(49-18)-1207. 65p. Dep. NTIS $5.45.

Life test studies of experimental fluidized-bed methanation catalysts produced another possible candidate for tests in the methanation PEDU. It is a promoted Mo—Al_2O_3 catalyst, similar to that used in PEDU Test No. 8, except that the metal loading is higher. Useful conversions were in the 85 to 95 percent range over the duration of the test. Gold model tests were run in an attempt to determine the jet penetration distance of the gas at the grid and at the upper feed nozzle. Breakdown of the equipment caused suspension of the tests. Both the cross-sectional model and the 6-in.-I.D. model are undergoing repair. BSM Test No. 91 was con-

ducted prior to PEDU Test No. 17. Useful conversions of 80 percent or higher were obtained. Two methanation PEDU tests were made during the quarter, Tests No. 16 and 17. The results of PEDU Test No. 16 showed the desirability of operating at lower feed gas temperatures and higher feed gas rates to achieve higher conversions in the upper zone of the reactor. Under these conditions, catalyst sintering in the grid area was also minimized (although not completely eliminated). PEDU Test No. 17 was ended prematurely because the catalyst had extremely high activity. Very high conversions were obtained but catalyst sintering and caking continued to present difficulties. These problems are believed to have been primarily due to: (1) lower-than-expected surface area of the catalyst, (2) the fact that the active metals were concentrated at surface sites rather than in pores, and (3) the fact that, through an oversight during the preparation of the catalyst, the metal loadings were some 62 percent higher than was actually desired. Analytical and data processing services continued in support of the entire program. (auth)

6328 (FE—1514-42) **Advanced coal gasification system for electric power generation. Multiple-fluidized-bed coal gasification system conceptual design and cost estimate, June 1974—June 1975.** (Westinghouse Electric Corp., Lester, Pa. (USA). Heat Transfer Div.). Jun 1975. Contract E(49-18)-1514. 234p. Dep. NTIS $8.00.

A conceptual design is presented for a coal gasification system of the size and configuration deemed proper to operate with a large utility-type turbine-generator. Presented are basic design theories, equipment configurations, process flow sheet, principal dimensions, operating principles, and a cost estimate. This report details a complete gasification system that processes 47 tons of coal and 15 tons of dolomite per hour into sulfur-free gaseous fuel having an LHV of 149.9 BTU/SCF at a temperature of 1600°F. This fuel will then operate a Westinghouse 501-D gas turbine, which will generate 95Mw when operating at ISO conditions. (auth)

6329 (FE—1527-5) **Gas generator research and development, clean fuel gas. Quarterly report, July—September 1975.** (Bituminous Coal Research, Inc., Monroeville, Pa. (USA)). 15 Oct 1975. Contract E(49-18)-1527. 21p. Dep. NTIS $4.00.

The overall objective of the program continues to be to develop processes for gasifying coal with emphasis on the production of a fuel gas. No liquids, tar, or char are produced as waste or by-product. Laboratory-scale coal gasification experimentation is to be continued, together with process and equipment development. The laboratory work will be conducted to improve the fluidized-bed coal gasification process, and to provide data for design of continuous or semi-continuous flow systems, together with the analysis and evaluation of results from larger scale experimentation. The primary purpose of the process and equipment development work is to translate results of laboratory studies into pilot-scale systems for use in further proving the process for commercial operation. The necessary experimental gasifier shall be built and operated to study process development of air- and oxygen-blown fluidized-bed systems and special systems using carbon dioxide as an oxidizer. Construction and pressure testing of the fluidized-bed gasification PEDU were completed. Following the completion of four minor items, a letter requesting acceptance of the plant was received on September 9, 1975. BCR has begun 30 days of mechanical checkout prior to issuing formal acceptance. No major problems have been encountered to date. Computer programming for the PEDU continued and several routines are being debugged. Technical services during the quarter included visits by several companies and the review of ERDA proposals by BCR personnel. (auth)

6330 (FE—1749-3) **Materials research for clean utilization of coal. Quarterly progress report, July 1—September 30, 1975.** (National Bureau of Standards, Washington, D.C. (USA)). 1975. Contract 14-32-0001-1749. 54p. Dep. NTIS $4.50.

Coal gasification processes require the handling and containment of corrosive gases and liquids at high temperature and pressures, and also the handling of flowing coal particles in this environment. These severe environments cause materials failures that inhibit successful and longtime operation of the gasification systems. The project entails investigations on the wear, corrosion, chemical degradation, fracture, and deformation processes that lead to the breakdown of metals and ceramics currently being utilized in pilot plants (and suffering failures). Studies will also be carried out on new candidate materials considered for improved performance. Special emphasis will be devoted to the development of test methods, especially short-time procedures, to evaluate the durability of materials in the gasification environments. These methods will focus on wear, impact erosion, stress corrosion, strength, deformation, slow crack growth and chemical degradation of refractories. Failure analysis of gasifier components, both metal and ceramic will be conducted as necessary. Failure reports from gasifiers will be compiled, abstracted and recommendations made to ERDA as to the appropriate action to be taken. All studies will be correlated with field inspections and failure analysis on in-service materials. (auth)

6331 (FE—1790-1) **Alloy catalysts with monolith supports for methanation of coal-derived gases. Phase I. Quarterly technical report, April 22—July 22, 1975.** Bartholomew, C.H. (Brigham Young Univ., Provo, Utah (USA)). 6 Aug 1975. Contract E(49-18)-1790. 74p. Dep. NTIS $4.50.

Investigations of new pellet- and monolithic-supported alloy catalysts for methanation of coal synthesis gas are reported. Alumina-supported nickel and nickel alloys were prepared, characterized by surface area measurements, and tested for methanation catalyst activity. To determine effects of sulfur poisoning on surface area, the adsorption of hydrogen on these catalysts was measured before and after exposure to hydrogen sulfide. A procedure for measuring adsorption of carbon monoxide on nickel underwent extensive testing and evaluation. In addition, screening and testing procedures to measure methanation catalyst activity were designed and tested. Preparation, adsorption, poisoning and analytical calibration systems were designed, constructed, and tested. Design of a high-pressure laboratory reactor was completed and the associated equipment and supplies ordered. (auth)

6332 (FE—1790-2) **Alloy catalysts with monolith supports for methanation of coal-derived gases. Phase I. Quarterly technical progress report, July 23—October 22, 1975.** Bartholomew, C.H. (Brigham Young Univ., Provo, Utah (USA)). 6 Nov 1975. Contract E(49-18)-1790. 48p. Dep. NTIS $4.00.

Investigations of new pellet- and monolithic-supported alloy catalysts for methanation of coal synthesis gas are reported. Alumina-supported alloys of nickel with ruthenium, rhodium, molybdenum, platinum, palladium, iron, and cobalt were characterized by surface area measurements and tested for methanation catalyst activity at ambient pressure, 225 and 250°C, and at space velocities of 30,000 and 60,000 hr^{-1}. To determine effects of sulfur poisoning on surface area, the adsorption of hydrogen and carbon monoxide on most of these catalysts was measured before and after exposure to hydrogen sulfide. In addition, pellet-supported molybdate nickel-copper, ruthenium-cobalt, and ruthenium-palladium alloy catalysts and monolithic-supported nickel catalysts were prepared. Reconstruction of a laboratory reactor to enable high-pressure operation was eighty percent completed. (auth)

6333 (FE—2029-1) **Gasification in pulverized coal flames. First quarterly progress report, July—September 1975 .** Laurendeau, N.M. (Purdue Univ., Lafayette, Ind. (USA). School of Mechanical Engineering). Oct 1975. Contract E(49-18)-2029. 36p. Dep. NTIS $4.00.

This project is concerned with the production of power and synthesis gases from pulverized coal via suspension gasification. Specifically, the concentric jet and vortex gasifiers, with separation of oxidation and reduction zones, will be investigated. Gasifier performance will be correlated with internally measured temperature and concentration profiles. A suction pyrometer will be used to simultaneously measure temperature and gas concentrations. Rapid species analysis will be provided by a UTI Q-30C mass spectrometer system. To date, a coal-handling facility has been developed, test cell design has been initiated, and preliminary literature searches have been made. A coal crusher, pulverizer, feeder, and sieve shaker are on order. Preliminary consultations are underway concerning the mass spectrometer system. (auth)

6334 (MERC/RI—75/2) **Chemical and mineralogical characterization of core samples from underground coal gasification sites in Wyoming and West Virginia.** Estep-Barnes, P.A.; Kovach, J.J. (Energy Research and Development Administration, Morgantown, W.Va. (USA). Morgantown Energy Research Center). Dec 1975. 20p. Dep. NTIS $3.50.

A comprehensive analytical scheme for the chemical, mineralogical and physical property characterization of coal cores has been developed. The scheme includes the determination of those properties that are important in the evaluation of the burning characteristics of coal, and will thus aid in the selection of areas favorable for underground coal gasification and in the optimization of this in-situ energy extraction process. Four coal cores were analyzed, two from a western underground coal gasification site near Hanna, Wyoming (Carbon County) and two from an eastern site near Pricetown, West Virginia (Wetzel County). To obtain a valid seam evaluation, analyses were obtained on 148 samples representing the total column of the coal interval from each of these four cores. From the analytical data, average properties for the coal interval of each core were derived for use in site-evaluation studies and for correlation with important operatingparameters in the underground gasification tests at these sites. Results are also presented for an additional nine samples selected from a fifth

coal core taken at the Hanna, Wyo. site. The compositional heterogeneity found by vertically sampling the entire coal column at the selected sites demonstrates the importance of carrying out detailed core analyses for an adequate bed assessment. On the other hand, the lateral continuity in chemical and mineralogical composition observed for the coal deposits at both the western and eastern sites indicates that stratigraphic variations are systematic and therefore predictable. (auth)

6335 (PERC/RI—75/6) **Influence of synthane gasifier conditions on effluent and product gas production.** Nakles, D.V.; Massey, M.J.; Forney, A.J.; Haynes, W.P. (Energy Research and Development Administration, Pittsburgh, Pa. (USA). Pittsburgh Energy Research Center). Dec 1975. 54p. Dep. NTIS $5.45.

Three critical conclusions regarding effluent production and treatment in Synthane as well as other steam-oxygen gasification systems are apparent: (1) Steady state effluent production rates differ dramatically from those during non-steady state gasifier operation, particularly reactor startup; (2) Process variables influenced by coal-injection geometry, e.g., coat heatup rate, product gas residence time, reaction temperature, and gas-solid contacting have a significant impact on steady state gasifier effluent production; and (3) Neither total product gas nor equivalent methane yield are affected by significant variation in coal-injection location. The first conclusion suggests that a substantial amount of existing data on effluent production during steam-oxygen gasification must be regarded as qualitatively accurate at best, since it was acquired largely by batch sampling effluents collected during startup and shutdown as well as during steady state operation of small-scale reactors. The second and third conclusions indicate strongly that effluent treatment by modified gasification reactor design represents at least a complement and quite possibly an alternative to large-scale treatment of gasifier effluents by conventional processing. (auth)

6336 (SAND—75-0669) **Instrumentation and process control development for in situ coal gasification. Fourth quarterly report, September—November 1975.** Northrop, D.A. (ed.). (Sandia Labs., Albuquerque, N.Mex. (USA)). Jan 1976. Contract AT(29-1)-789. 45p. Dep. NTIS $4.00.

The instrumentation effort for Phases 2 and 3 of the Second Hanna In Situ Coal Gasification Experiment was fielded and background data obtained prior to the initiation of Phase 2 on November 25, 1975. A total of over 600 channels of instrumentation in 15 instrumentation wells and two surface arrays was fielded for the instrumentation techniques under evaluation. The feasibility of the passive acoustic technique to locate the source of process-related noises has been demonstrated; its utility is presently hampered by the inexact definition of signal arrivals and the lack of automated signal monitoring and analysis systems. A revised mathematical model for the electrical techniques has been developed which demonstrates the potential for remote monitoring. (auth)

6337 (UCRL-Trans—10979) **Analysis of several technical factors in the underground gasification of brown coal.** Lavrov, N.V.; Kulakova, M.A.; Kazachkova, S.Ts. Translated from *Tr. Inst. Proizvod. Opyt, Vses. Nauchno-Issled. Inst. Ispol'z. Gaza Nar. Khoz. Podzemn. Khraneniya Nefti, Nefteprod. Szhizhennykh Gazov;* No. 5, 133-137(1971). 11p. Dep. NTIS $3.50.

An analysis of the operational data obtained from the underground gasification of brown coal revealed an interrelationship among the basic parameters of the process: the heating value of the gas, the intensity of the draft, and the thickness of the coal seam. The results suggest that the gasification process should be intensified in the gasification of thick coal seams. The experimental data show that preheating the draft has a significant effect on process characteristics in the underground gasification of fuels. (auth)

6338 (PERC/TPR—75/2) **Analyses of tars, chars, gases, and water found in effluents from the synthane process.** Forney, A.J.; Haynes, W.P.; Gasior, S.J.; Johnson, G.E.; Strakey, J.P. Jr. (Energy Research and Development Administration, Pittsburgh, Pa. (USA). Pittsburgh Energy Research Center). Nov 1975. 11p. Dep. NTIS $4.50.

Extensive studies have been made of the various effluents found in the Synthane coal-to-gas process. Analyses have been made of the waters, gases, and trace elements present in some of the streams. Results of analyses show the water effluents are the area where extensive research is needed. (auth)

LIQUEFACTION

6339 (ANL—75-76) **Physical parameters in synthoil process. Quarterly report for the period July—September 1975.** Fischer, J.; Lo, R.; Nandi, S.; Fredrickson, D.; Bump, T.; Mulcahey, T.; Huang, H.; Jonke, A. (Argonne National Lab., Ill. (USA)). Dec 1975. Contract W-31-109-Eng-38. 17p. Dep. NTIS $4.50.

This work is being done in support of the development of processes for converting coal to liquid fuel of low S content, suitable for use in power production. Most of the effort is intended to produce information applicable to the SYNTHOIL Process. In the SYNTHOIL Process for converting coal to a low-S fuel oil, coal is liquefied and hydrodesulfurized in a turbulent-flow, catalytic packed-bed reactor. A slurry of coal in recycled oil is reacted with hydrogen at 450°C and 2,000 to 4,000 psi in the presence of $Co—Mo/SiO_2—Al_2O_3$ catalyst. The turbulent flow of fluid prevents the coal's mineral matter from settling and plugging the reactor. The gross liquid products are centrifuged to remove the unreacted solids. The centrifuged liquid product is a low-S, low-ash fuel. The following four tasks are included: (1) heat of reaction of hydrogen with coal slurries; (2) heat transfer coefficient; (3) additives to facilitate separation of solids from liquids; and (4) catalyst testing. These are now in the planning stage of development. (auth)

6340 (FE—0479-3) **Coal conversion processes. Part I. Liquefaction. R and D report No. 66. Interim report No. 4, August 1973—August 1974.** Wen, C.Y.; Henry, J.D.; Patel, B.S.; Han, B.K.; McMichael, W.J. (West Virginia Univ., Morgantown (USA). Dept. of Chemical Engineering). Apr 1975. Contract E(49-18)-0479. 67p. (OCR—66-INT4). Dep. NTIS $5.45.

Available experimental data on the dissolution of coal into solvent-hydrogen mixtures were analyzed to obtain a mathematical expression for the rate of dissolution. The rate of dissolution was found to depend exponentially on the hydrogen partial pressure and was proportional to the amount of undissolved organic material per unit volume of slurry. The rate was found also to depend on the type of reactor and coal. The low activation energy for coal dissolution appears to indicate that the dissolution may be controlled by the diffusion of some species in the solution phase. The removal of ash from coal-derived liquids by filtration and centrifugation was examined and the economics of the separation has been analyzed in detail for the COED, SRC, and Synthoil processes. In the SRC process the ash separation represented a major portion of the overall fixed capital investment ranging from 23 to 50% for the SRC process. (auth)

6341 (FE—1224-36) **Project lignite quarterly technical progress report No. 1, July, August, and September 1974.** Severson, D.E. (North Dakota Univ., Grand Forks (USA)). 31 Mar 1975. Contract 14-32-0001-1224. 25p. Dep. NTIS (US Sales Only) $4.50.

A bench-scale pressure autoclave was used in liquefaction tests with lignite to investigate process parameters. A test series in which recovered solvent from a previous test was used in subsequent experiments showed that, for at least three cycles, quality of solvent did not decrease and liquefaction was maintained at a high level. Dehydration of the lignite prior to liquefaction was found to affect liquefaction adversely, although the carbon dioxide content of the product gases was significantly reduced. Storage of lignite under water, in air, or in nitrogen for periods up to twenty-four weeks did not significantly alter liquefaction characteristics. Three supportive research projects were continued. Benzene extraction of the reacted lignite-slurry mixture appeared to be an effective alternate to the filtration step. Ash removal of ninety-eight percent has been achieved in batch-autoclave tests. Laboratory data are being used to design a solids-liquid separation unit for the PDU. Petrographic analysis of reacted lignite at various severity levels showed varying response to liquefaction by the lignite macerals. A titration technique for determination of basic nitrogen content was developed, and screening studies were initiated to evaluate operating conditions and techniques prior to catalyst activity studies for hydrogenation of solvent refined lignite. Work on construction of the Process Development Unit continued with emphasis on building renovation and fabrication of vessels. The status of various phases of the project is summarized. (auth)

6342 (FE—1224-37) **Project lignite quarterly technical progress report No. 2, July, August, and September 1974.** Severson, D.E. (North Dakota Univ., Grand Forks (USA)). 15 Apr 1975. Contract E(49-18)-1224. 20p. Dep. NTIS $4.50.

The bench-scale liquefaction tests continued with five passes of recycled solvent through successive experiments completed. The initial solvent was a carbon black feedstock. No significant changes in solvent quality was noted, and liquefaction yields remained nearly constant at 57.7 to 58.9 percent solvent-refined lignite on a MAF basis. Solvent recovery averaged slightly over 100 percent and a decrease was noted in solvent retention in the filter cake, indicative of improving filterability with recycle. Storage of lignite under water, in nitrogen, or in air for up to 36 weeks had no highly significant effect on liquefaction properties, though a slight trend toward poorer filtration and lower conversion for the lignite stored in air may be developing. In supportive research activities,

hydrogenation of solvent refined-lignite to distillable products indicated that presulfiding of catalyst gave higher overall conversions with reduced yield of gaseous products. Fluidization studies were completed to determine parameters for a conventional-dense fluid bed with lignite or sand or cracking catalyst in a 4-in.-I.D. tube. A system was designed and constructed for investigation of fast fluidization. Construction and installation of components for the continuous Process Development Unit were accelerated. Generally good progress was made, though delays in scheduled shipment of equipment and instrumentation components are becoming serious in some instances. Electrical supplies seem to be very short. The status of construction in the various process areas is summarized. (auth)

6343 (FE—1224-44) **Project lignite quarterly technical progress report No. 4, January, February, and March 1975.** Severson, E. (North Dakota Univ., Grand Forks (USA)). 26 Aug 1975. Contract E(49-18)-1224. 28p. Dep. NTIS $5.00.

Two 8-hr shakedown runs were made with the Process Development Unit (PDU) to determine operability of equipment and to train operators. Test included circulating first a lube oil-fuel oil mixture, and then FS120 solvent plus nitrogen. No solid was fed to the process. Several problem areas with equipment and instrumentation were discovered and are being corrected. Construction activities were concentrated in the solids-liquid separation and SRL hydrogenation areas. Most other areas are now operational. Recycle of recovered solvent, starting initially with FS120, through the batch-liquefaction processes has been completed for 5 cycles. No significant changes in conversion, product distribution or solvent characteristics were noted. It was indicated that sufficient solvent could be recovered to sustain the process in continuous operation. In catalytic hydrogenation of SRL, a relatively high conversion was realized without solvent. The aromatic contents of hydrogenated products increased with a decrease in solvent:SRL ratio, while maximum conversion was obtained at a solvent:SRL ratio of 1:1. In related work, conventional boiling bed and "fast" fluidization of lignite, catalyst, and sand particles was achieved in bench-scale equipment. High slip-velocities of particles in fast fluidization approached that of the superficial air velocity indicating extensive back-mixing. (auth)

6344 (FE—1517-22) **Evaluation of high pressure-high temperature pressure vessel end closures and flanged connections. Special report.** (Fluor Engineers and Constructors, Inc., Los Angeles, Calif. (USA)). Sep 1975. Contract E(49-18)-1517. 36p. Dep. NTIS $4.00.

The study evaluates the applicability of specific types of pressure vessel end closures and flanged connections for high-pressure, high-temperature processes in coal liquefaction plants. The primary area of investigation is an analysis of the combined effects of pressure (3000 to 5000 psig), temperature (up to 900°F), and external mechanical loads. The results of the study summarize the major engineering and design considerations and emphasize the need for thorough analysis and adequate testing. The final section presents a recommended test program to verify the suitability of selected design types for future use in coal-liquefaction plants. (auth)

6345 (FE—1775-1) **Commercial complex conceptual design/economic analysis. Oil and power by coed based coal conversion. R and D report No. 114. Interim report No. 1.** (Parsons (Ralph M.) Co., Pasadena, Calif. (USA)). Sep 1975. Contract E(49-18)-1775. 203p. Dep. NTIS $7.60.

A conceptual design for a commercial coal conversion plant based on COED pyrolysis technology is presented. The plant processes a nominal 25,000 tons/day of clean, sized high-sulfur coal to produce approximately 28,000 b/day of low-sulfur synthetic crude oil (SYNCRUDE) plus about 830 MW of electricity for export sale and 760 long tons/day of S. Details of the design are presented. A parametrics economic analysis is presented. Based on first quarter 1974 dollars, the estimated grass roots fixed capital investment is $1 billion. Product selling prices required to achieve a 10% DCF rate of return for a debt equity ratio of 65/35 and 9% interest rate are SYNCRUDE at $15/barrel and electricity at 25 mills per KWH; other combinations of product selling prices exist for this multi-product plant. Sensitivity analyses for the key economic parameters are given. A basis for assessing the potential commercial use of this technology is provided. (auth)

6346 (FE—2034-1) **Catalytic hydrogenation of coal-derived liquids. Interim report, September—November 1975.** Berg, L.; McCandless, F.P. (Montana State Univ., Bozeman (USA)). Dec 1975. Contract E(49-18)-2034. 17p. Dep. NTIS $4.00.

It is the object of this research to convert coal to clean distillate fuels. This program will be limited to research on the product from existing coal liquefaction processes. Liquefied coal will be converted by a catalytic hydrogenation at elevated temperatures and pressures. Samples of the products from PAMCO, H-oil, COED, and Cresap processes will be obtained. They will be heated and pumped, with and without solvent, into a catalytic reactor in the presence of hydrogen and other reducing gases. Variables to be investigated will include temperatures, pressure, space velocity, hydrogen-to-oil ratio, chemical nature of the solvent. The catalysts to be studied will include nickel molybdate and sulfide, cobalt molybdate and sulfide, nickel tungstate, and other combinations on carriers such as mordanites and other molecular sieve types. (auth)

6347 (ORNL—5093) **Coal Technology Program quarterly progress report for the period ending September 30, 1975.** (Oak Ridge National Lab., Tenn. (USA)). Dec 1975. Contract W-7405-eng-26. 69p. Dep. NTIS $6.00.

In hydrocarbon research the effort in experimental development focused upon modification of the atmospheric pressure reactor and successful completion of the first two runs using H_2 as the fluidizing gas. Effort was focused on installation and initial shakedown testing of the bench-scale hydrocarbonization system that is designed to process coal at a nominal rate of 10 lb/hr at pressures up to 300 psig and temperatures up to 1200°F. In solid-liquids separation work, solvent agglomeration-fractionation (SAF), followed by settling at elevated temperatures and pressures, continues to show promise as a solids separation scheme for Solvent Refined Coal (SRC) and similar processes. A preliminary economic evaluation of SAF, followed by settling and filtration of the bottoms material, shows a significant cost advantage over conventional rotary drum filtration. In the engineering evaluations of nuclear process heat for coal conversion, a preliminary study of the energy intensiveness and unit costs of various energy transportation modes was completed. A pressurized gasifier was selected and process flowsheets and material balances for the gasifier and gas-treating section were prepared for Synthoil. Research in the biomedical and environmental program continues. (auth)

6348 (SAND—75-0651) **Chemical studies on SYNTHOIL process. Quarterly report, September 1—November 30, 1975.** Mullendore, A.W.; Lieberman, M.L. (Sandia Labs., Albuquerque, N.Mex. (USA)). Dec 1975. Contract AT(29-1)-789. 59p. Dep. NTIS $5.50.

This is the first quarterly report of a two year program of a study in support of the Pittsburgh Energy Research Center's SYNTHOIL process for coal liquefaction. The overall program consists of three tasks: Task 1, "Catalyst Improvement" in which the mechanisms of catalyst deactivation and methods of reactivation will be explored; Task 2, "Ash Effects" in which the effect of the mineral content of coals on liquefaction will be assessed in autoclave experimens; and Task 3, "Kinetic Studies" in which a bench-scale reactor will be set up to study the effects of process parameters on the kinetics of hydrodesulfurization and liquefaction. Progress in each task area is reported. Various analytical techniques were evaluated for Task 1 with respect to their ability to analyze structural and compositional aspects of catalysts in the new, used, and regenerated conditions. Surface areas, pore volumes, and pore size distributions were measured and correlated with the microstructural features revealed by electron microscopy. The design of the autoclave facility for Task 2 was completed. The system will utilize a fail-safe concept that will permit operation within a manned laboratory area. The design of the modularized reactor system for Task 3 is nearly complete. Some of the significant design features are high-pressure strain gage transducers for pressure measurements, load cell gravimetric measurements of liquid transfer rates, intermediate position product-withdrawal facilities for both preheater and reactor, and digitization of analog instrumentation outputs for a data acquisition system. (auth)

SOLVENT EXTRACTION

6349 (FE—496-109) **Solvent Refined Coal (SRC) process. Quarterly report, July—September 1975.** (Pittsburg and Midway Coal Mining Co., Kansas City, Mo. (USA)). Oct 1975. Contract E(49-18)-496. 50p. Dep. NTIS $4.00.

Progress is summarized for the Solvent Coal (SRC) Project by the Pittsburg and Midway Coal Mining Co. Activities include the operation of the Solvent Refined Coal Pilot Plant at Ft. Lewis, Washington and process development performed at the Merriam, Kansas Laboratory. (auth)

PROPERTIES

6350 (BERC/RI—76/2) **Compositional analyses of synthoil from West Virginia coal.** Woodward, P.W.; Sturm, G.P. Jr.; Vogh, J.W.; Holmes, S.A.; Dooley, J.E. (Energy Research and Development Administration, Bartlesville, Okla. (USA). Bartlesville Energy Research Center). Jan 1976. 24p. Dep. NTIS $3.50.

A synthetic crude oil (synthoil) derived from West Virginia, Pittsburgh seam coal by the Synthoil process was separated into three distillates and a residuum fraction. The <207°C distillate was further separated and characterized by gas chromatography and spectral techniques. The 207 to 363°C and 363 to 531°C boiling distillates were further separated and characterized by methods developed by the Bureau of Mines for characterization of heavy ends of petroleum, but with slight modifications. Each of the higher boiling distillates was separated by dual-pack adsorption chromatography into four concentrates: saturates, monoaromatics, diaromatics, and polyaromatic-polars. The saturates were characterized directly by mass spectrometry. Both the monoaromatic and diaromatic concentrates were further separated by gel-permeation chromatography (GPC) before characterization by GPC-mass spectral (MS) correlations and nuclear magnetic resonance spectrometry (NMR). Acids and bases were extracted from the polyaromatic-polar concentrates before GPC separation and mass spectral analyses. The resulting data indicatecompound type similarities among this synthetic crude oil (Synthoil syncrude), other syncrudes and petroleum crude oils. The similarities suggest that much of present petroleum processing technology, with some modifications, is applicable to processing syncrudes derived from coal. The procedures and methods used are satisfactory for characterizing complex synthetic crude oils. (auth)

6351 (BM-RI—8038) **Precision tests on neutron sulfur meter in coal preparation plant.** Hall, A.W.; Martin, J.W.; Stewart, R.F.; Poston, A.M. (Bureau of Mines, Morgantown, W.Va. (USA). Morgantown Energy Research Center). 1975. 15p. Dep. NTIS $4.00.

6352 (UCRL-Trans—10973) **Industrial classification of the varieties of brown coal in the U.S.S.R.** Svyatets, I.E.; Agroskin, A.A. Translated from *Khim. Tverd. Topl.;* **1**: 33-41(1975). 18p. Dep. NTIS $4.25.

An industrial classification of Soviet brown coals is proposed, differentiating the coals by their degree of metamorphism, petrographic composition, and degree of oxidation. The classification parameters adopted are as follows: for the degree of metamorphism—the content of moisture on ash-free coal; for petrographic composition—the yield of volatiles on the combustible mass; and for the degree of oxidation—the calorific value on the combustible mass. (auth)

WASTE MANAGEMENT

6353 (CONF-751215—2) **Tapered fluidized-bed bioreactor for treatment of aqueous effluents from coal conversion processes.** Scott, C.D.; Hancher, C.W.; Holladay, D.W.; Dinsmore, G.B. (Oak Ridge National Lab., Tenn. (USA)). 1975. 16p. Dep. NTIS $4.50.

From EPA symposium on environmental aspects of fuel conversion technology; Hollywood, Florida, USA (15 Dec 1975).

A bioreactor system based on a tapered fluidized bed is under development for the microbiological degradation of hazardous organic compounds expected in aqueous effluent waste streams from coal conversion processes. The concept will be used with fluidized particles having adhering microorganisms. The use of a fluidized reaction medium alleviates operational problems associated with biomass buildup and allows easy removal or addition of the active materials. The tapered reactor tends to stabilize the fluidized bed while allowing a much wider range of operating conditions. Preliminary experimental results from a study made with a 3-in.-diam tapered fluidized-bed reactor that contained adhering Pseudomonas bacteria and operated aerobically indicate that the phenol content of a feed stream can be reduced to less than 25 ppb. This concept is compatible with multistage operation, and scale-up is considered practical. (auth)

ENVIRONMENTAL ASPECTS

6354 (FE—1772-3) **Site evaluation survey, Clean Boiler Fuel Demonstration Plant. Final report, task assignment number 1.** (Dravo Corp., Pittsburgh, Pa. (USA). Chemical Plants Div.). Aug 1975. Contract E(49-18)-1772. 154p. Dep. NTIS $6.75.

An evaluation is presented of sites proposed by various states for the location of a clean boiler fuel demonstration plant. Illinois, Indiana, Kentucky, Ohio, Pennsylvania, and West Virginia nominated 16 sites, ranging from one to five sites per state. The information, provided by each state, was furnished to Dravo by ERDA for an independent evaluation. Site evaluations were made by conducting a general suitability assessment of each site followed by detailed evaluation of the 8 sites considered to be among the most favorable. It is concluded that, on the basis of the information made available to Dravo, the site located in St. Clair County, near New Athens, Illinois, is the preferred location for the Clean Boiler Fuel Demonstration Plant. (auth)

6355 (FE—2019-1) **Environmental effects from leaching of coal conversion by-products. Interim report, July—September 1975, for the period June—September 1975.** Van Meter, W.P.; Erickson, R.E. (Montana Univ., Missoula (USA)). Oct 1975. Contract E(49-18)-2019. 9p. Dep. NTIS $3.50.

Descriptions are given of initial attempts to achieve complete dissolving of residue materials for the purpose of assay by atomic absorption analyses for seven trace metals. Some preliminary analytical results are given. An exploratory column leaching run is reported, including flow characteristics and analysis results on the first few effluent protions collected. The effluent from this run is highly alkaline. This could be the reason for the slow, constant rate of metal ion removal, governed by the solubilities of the oxides. It is anticipated that release of metals will be more rapid, and will vary in rate more quickly, when the other eluants are used because the ionic solutes in them will allow ion exchange replacement. (EJH)

MINING

6356 (UCID—16968) **Calculation of TNT coal fracturing in air and water.** Cheung, H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 4 Dec 1975. Contract W-7405-Eng-48. 10p. Dep. NTIS $4.00.

To provide preliminary estimates of the amount of coal that an explosive charge could shatter to an extent suitable for transfer as a water slurry, we studied TNT coal fracturing in air and water. We used the SOC code to compute the failure shear strain and considered the amount of coal fractured to be that volume in which the strain had reached 10%. We determined that the quantity of coal fractured per gram of TNT was independent of the size of the charge and showed that this is also true for PETN and Teledet. The amount of coal fractured is, however, approximately proportional to the energy of the explosive. We found that a shell of water surrounding the charge did affect its fracturing ability, and the effect varied with the shell thickness. The stress in the coal caused by an explosive charge in water was far greater than that caused by a charge in air.

COMBUSTION

6357 (ANL/ES-CEN—1011) **Development program on pressurized fluidized-bed combustion. Annual report, July 1, 1974—June 30, 1975.** Vogel, G.J.; Cunningham, P.; Fischer, J. (Argonne National Lab., Ill. (USA)). Jul 1975. Contract 14-32-0001-1780. 217p. Dep. NTIS $7.60.

The feasibility of using fluidized-bed combustors in power and steam plants is being evaluated. The concept involves burning fuels such as coal in a fluidized bed of either a naturally occurring, calcium-containing limestone or dolomite or in a synthetically prepared calcium-containing stone. The calcium oxide in the stone reacts with the sulfur released during combustion to form calcium sulfate, which remains in the bed, thus decreasing the level of SO_2 in the flue gas. Levels of NO/sub x/ in the flue gas are also low. The effect of operating variables and type of stone on the levels of SO_2 and NO/sub x/ is being determined. Behavior of trace elements during combustion has been preliminarily evaluated. The properties of a fluidized bed at minimum fluidization at different temperatures and pressures have been determined. The $CaSO_4$ produced in the combustion process is regenerated to CaO for reuse in the combustor by reductive decomposition at 1095°C (2000°F). The effects of operating variables on sulfur release during regeneration are being evaluated. Another regeneration process, solid-solid reaction of $CaSO_4$ with CaS, is also being investigated. Fundamental investigations of the kinetics of sulfation and regeneration reactions for the natural and synthetic stones are continuing. A model for the sulfation reaction is presented. The status of the new combustor andancillary regenerator equipment is discussed. (auth)

6358 **FLUIDISED COMBUSTION. VOLUME I. INTERNATIONAL CONFERENCE ON FLUIDISED COMBUSTION HELD AT LONDON, ENGLAND, 16—17 SEPTEMBER 1975.** Institute of Fuel Symposium Series No. 1. London; United Kingdom of Great Britain and Northern Ireland (UK); Institute of Fuel (1975). vp. (CONF-750994—P1).

From Conference on fluidised combustion; London, UK (16 Sep 1975).

Models, mechanisms, combustion of coal, oil, gas, and waste, and pollution are discussed in 24 papers. An abstract was prepared for the one ERDA-sponsored paper. (EJH)

PETROLEUM

EXPLORATION

6359 (PB—238668) **Molecular and isotopic composition of two seep gases from the Gulf of Mexico.** Brooks, J.M.; Gormly, J.R.; Sackett, W.M. (Texas Agricultural and Mechanical Univ., College Station (USA)). Sep 1974. 6p. Geophys. Res. Lett.; 1: No. 5, 213-216(Sep 1974).

Gas samples collected on the Texas—Louisiana continental shelf from two natural seeps had molecular and isotopic compositions highly indicative of a biogenic origin. Bottom seepage of natural gases appears to be a common phenomenon on the northwestern continental shelf of the Gulf of Mexico. These gas seeps which are generally associated with topographic highs can readily be detected by commercial sonar equipment. The acoustical detection of the location of gas seeps is viewed in most of the literature as a petroleum exploration tool based on the concept that seeps are of a petrogenic origin and therefore indicate the location of oil and gas reservoirs. The authors present evidence here that at least part of the gas seepage from the continental shelf of the Gulf of Mexico is of biogenic as opposed to a petrogenic origin. (GRA)

DRILLING AND PRODUCTION

6360 (AERE-R—8067) **Underwater inspection of fixed offshore platforms. A review and assessment of techniques.** Bainton, K.F.; Silk, M.G.; Williams, N.R.; Davies, D.M.; Lyon, I.R.; Peters, V. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Jul 1975. 62p. (RR-SMT/R—7403). Dep. NTIS (US Sales Only) $6.25. UK pounds2.00.

The techniques applicable to both present gas production platforms and planned oil production platforms in water to at least 600 ft are reviewed. The limitations of these techniques are discussed and possible means of reducing them are indicated. The minimization of the problems encountered in underwater inspection is considered. The options explored are providing the diver with better equipment, introducing equipment not requiring operation by a diver skilled in nondestructive testing, replacing divers with fixed detectors or scanner on the rig or with detectors fixed to submersibles, and setting realistic inspection standards.

PROCESSING

6361 (PB—236406) **Compound-type separation and characterization studies for a 370 to 530°C distillate of Recluse, WY, crude oil.** Hirsch, D.E.; Dooley, J.E.; Vogh, J.W.; Thompson, C.J. (Bureau of Mines, Bartlesville, Okla. (USA). Bartlesville Energy Research Center). Aug 1974. 31p. (BM-RI—7945). NTIS $3.75.

The Bureau of Mines has developed a systematic procedure for separation, characterization, and semiquantitative analysis of high-boiling (350 to 550°C) distillates of crude oils. Isothermal and molecular distillation were used to prepare the 370 to 530°C distillate of recluse, Wyo.,crude oil. The distillate was separated into fractions by chemical treatment, silica-alumina gel adsorption, and gel permeation chromatography (GPC). The fractions were analyzed by use of GPC correlations and mass and nuclear magnetic resonance (NMR) spectrometry. The increased knowledge of petroleum composition obtained from the data will contribute to improved petroleum processing and utilization and energy conservation. (GRA)

ENVIRONMENTAL ASPECTS

6362 (AD/A—006471) **Source identification of oil spills by pattern recognition analysis of natural elemental composition. Interim technical report No. 7, August 1974—January 1975.** Duewer, D.L.; Kowalski, B.R.; Schatzki, T.F. (Washington Univ., Seattle (USA). Lab. for Chemometrics). Feb 1975. Contract N00014-67-A-0103-0036. 42p. NTIS $3.75.

Pattern recognition techniques are applied to the problem of determining the source of an oil spill. The utility of various elements for making this determination is assessed. Classification procedures using comparisons of the field sample to single known source samples and to multiple ("fuzzy") artificially weathered source samples of a given type are presented and discussed. (GRA)

NATURAL GAS

DRILLING AND PRODUCTION

6363 (PNE-MHF—3) **Rio Blanco massive hydraulic fracture well RB-MHF-3 as-built report.** (CER Geonuclear Corp., Las Vegas, Nev. (USA)). Aug 1975. 138p. Dep. NTIS $10.00.

The complete drilling operation for well RB-MHF-3, including the surface equipment and services, downhole equipment and services, and cementing, are reported. Appendices give the daily drilling reports, casing records, drilling bit summary, mud properties, core analysis data, drill stem test data, and gas and water analyses. (JSR)

6364 (UCRL—51919) **Effect of stress on the microstructure of a graywacke sandstone from the site of the Rio Blanco gas-stimulation experiment.** Dengler, L.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Sep 1975. Contract W-7405-Eng-48. 34p. Dep. NTIS $4.00.

Project Rio Blanco was designed to increase rock permeability in an existing gas reservoir by fracturing the rock with a vertical array of three simultaneous nuclear explosions. The project site was CER Geonuclear hole RB-E-01, Section 14, T35, R98W, Rio Blanco County, in the Piceance Creek Basin of northwest Colorado. The most essential part of this project was to produce fracturing in, and thereby to increase the permeability of, the reservoir rock. This report contains the results of optical and scanning electron microscope (SEM) studies done on unstressed and laboratory-stressed samples of graywacke sandstone from the 6458-ft level of the emplacement hole. Laboratory-stressed samples were from uniaxial-stress and uniaxial-strain tests made as part of equation-of-state measurements used to provide input parameters for preshot code calculations. (auth)

OIL SHALES AND TAR SANDS

OIL PRODUCTION, RECOVERY, AND REFINING

IN SITU METHODS, TRUE AND MODIFIED

6365 (CONF-751101—62) **In situ oil shale processing research in the Rock Springs, Wyoming, area.** Carpenter, H.C. (Energy Research and Development Administration, Laramie, Wyo. (USA). Laramie Energy Research Center). 1975. 28p. Dep. NTIS $5.00.

From Joint meeting of the American Nuclear Society and the Atomic Industrial Forum; San Francisco, California, USA (16 Nov 1975).

A number of fracturing and recovery experiments have been conducted in the Rock Springs area. Experimental work on Rock Springs sites 1, 3, 5, and 8 was confined to fracturing and on sites 2, 4, 6, and 7 some retorting and recovery research was conducted following the fracturing effort. Rock Springs sites 4 and 6 were major recovery experiments with site 4 being the more successful of the two. Rock Springs site 4 was fractured by detonating nitrolycerin in a naturally occurring permeable zone and in a horizontal sand-propped hydraulic fracture. The current experiment at Rock Springs site 9 is based on a concept resembling the fracturing on site 4. Three horizontal sand-propped hydraulic fractures were used. Two explosive fracture treatments were conducted. The site was evaluated and preparations for a recovery experiment are in progress. Ten wells were drilled around the site to monitor possible environmental effects of migrating fluids.

PROPERTIES AND COMPOSITION

6366 **Polar constituents isolated from Green River oil shale.** Anders, D.E.; Doolittle, F.G.; Robinson, W.E. (Laramie Energy Research Center, WY). *Geochim. Cosmochim. Acta;* **39**: 1423-1430(1975).

The mass spectrometric ir absorption, and NMR data are given for 22 compounds obtained from a polar fraction of Green River shale. The major constituents analyzed are believed to be of the following compositional types: C/sub n/H/sub 2n/O (cyclohexanols and chain isoprenoid ketones), C/sub n/H/sub 2n-10/O (tetralones and indanones), C/sub n/H/sub 2n-7/N (tetrahydroquinolines), C/sub n/H/sub 2n-11/N (quinolines), C/sub n/H/sub 2n-1/NO(alkoxypyrrolines), C/sub n/H/sub 2n-5/NO_2 (maleimides), C/sub n/H/sub 2n-8/ (tetralins), C/sub n/H/sub 2n-

12/(naphthalenes) and C/sub n/H/sub 2n-14/ (benzylbenzenes). Information about nitrogen, oxygen, and aromatic constituents indigenous to Green River shale is expanded. (auth)

FISSION FUELS

EXPLORATION

6367 (GJO—1627(Pt.1)) **Investigation of Alaska's uranium potential.** Eakins, G.R. (Alaska State Dept. of Natural Resources, College (USA). Div. of Geological and Geophysical Surveys). 1 Jun 1975. Contract AT(05-1)-1627. 445p. Dep. NTIS $12.75.

Of the various geographical regions in Alaska that were examined in an exhaustive literary search for the possibility of uranium—either vein type or sedimentary—six offer encouragement: the Copper River Basin, the alkaline intrusive belt of west-central Alaska and Selawik Basin area, the Seward Peninsula, the Susitna Lowland, the coal-bearing basins of the north flank of the Alaska Range, the Precambrian gneisses of the USGS 1:250,000 Goodnews quadrangle, and Southeastern Alaska, which has the sole operating uranium mine in the state. Other areas that may be favorable for the presence of uranium include the Yukon Flats area, the Cook Inlet Basin, and the Galena Basin. (auth)

6368 (GJO—1627(Pt.2)) **Investigation of Alaska's uranium potential. Part II. Map of the granitic rocks of Alaska. Regional distribution and tectonic setting of Alaskan alkaline intrusive igneous rocks.** Forbes, R.B. (Alaska Univ., College (USA). Geophysical Inst.). 1 Jun 1975. Contract AT(05-1)-1627. 160p. Dep. NTIS $7.75.

The regional distribution and tetonic setting of alkaline intrusive igneous rocks in Alaska are described. A map of granitic rocks in the state is included. (LK)

6369 (GJO—1635-1) **Multispectral processing of ERTS-A (LANDSAT) data for uranium exploration in the Wind River Basin, Wyoming: a visible region ratio to enhance surface alteration associated with roll-type uraium deposits. Final report, June 1974—July 1975.** Salmon, B.C.; Pillars, W.W. (Environmental Research Inst. of Michigan, Ann Arbor (USA)). Jul 1975. Contract AT(05-1)-1635. 129p. Dep. NTIS $7.00.

The purpose of this report is to document possible detection capabilities of the LANDSAT multispectral scanner data for use in exploration for uranium roll-type deposits. Spectral reflectivity, mineralogy, iron content, and color paramenters were measured for twenty natural surface samples collected from a semiarid region. The relationships of these properties to LANDSAT response-weighted reflectances and to reflectance ratios are discussed. It was found that the single ratio technique of multispectral processing is likely to be sensitive enough to separate hematitic stain, but not limonitic. A combination of the LANDSAT R/sub 5,4/ and R/sub 7,6/ ratios, and a processing technique sensitive to vegetative cover is recommended for detecting areas of limonitic stain. Digital level slicing of LANDSAT R/sub 5,4/ over the Wind River Basin, after geometric correction, resulted in adequate enhancement of Triassic redbeds and lighter red materials, but not for limonitic areas. No recommendations for prospects in the area were made. Information pertaining to techniques of evaluating laboratory reflectance spectra for remote sensing applications, ratio processing, and planimetric correction of LANDSAT data is presented qualitatively. (auth)

FEED PROCESSING

6370 (ORNL—5109) **Uranium tailings bibliography.** Holoway, C.F.; Goldsmith, W.A.; Eldridge, V.M. (Oak Ridge National Lab., Tenn. (USA)). Dec 1975. Contract W-7405-eng-26. 97p. Dep. NTIS $6.50.

A bibliography containing 1,212 references is presented with its focus on the general problem of reducing human exposure to the radionuclides contained in the tailings from the milling of uranium ore. The references are divided into seven broad categories: uranium tailings pile (problems and perspectives), standards and philosophy, etiology of radiation effects, internal dosimetry and metabolism, environmental transport, background sources of tailings radionuclides, and large-area decontamination. (JSR)

ENRICHMENT

GASEOUS DIFFUSION

6371 (K-M—6124) **Gaseous diffusion operations.** Sommerfeld, K.W. (Union Carbide Corp., Oak Ridge, Tenn. (USA). Nuclear Div.). 1975. 25p. (CONF-751145—1). Dep. NTIS $4.50.

From Uranium enrichment conference; Oak Ridge, Tennessee, USA (11 Nov 1975).

The explanations accompanying a series of slides to represent pictorially gaseous diffusion plant operation are presented. The slides were selected to describe sequentially the normal series of steps that occur when feed is shipped to a diffusion plant and moves through the various auxiliary steps prior to entering the separation cascade. They also include the activities normally associated with product withdrawal and customer shipment. (JSR)

LASER EXCITATION

6372 (UCRL-Trans—10964) **Procedure and device for the separation of an isotope by selective ionization.** Kantrowitz, A. Nov 1975. Translation of Belgian Patent No. 807,442. 21p.

A procedure for the separation of isotopes by selective ionization and which efficiently uses an isotope source is described. A promising technique for higher yield separation of the ^{235}U isotope includes selective ionization of this isotope in uranium vapor, without a concomitant ionization of the ^{238}U isotope present in the vapor. (LK)

6373 (UCRL-Trans—10963) **Procedure for isotope enrichment.** Levy, R.H. Nov 1975. Translation of Belgian Patent No. 807,118. 26p. Dep. NTIS $5.00.

A method for separating ^{235}U and ^{238}U by selective ionization is described. (LK)

FUELS PRODUCTION AND PROPERTIES

6374 (CONF-750827—, pp 47-58) **Development of disposition criteria derivation methodology for commercial fuel cycle facilities.** Waite, D.A.; Jenkins, C.E. Sep 1975.

From Conference on decontamination and decommissioning of ERDA facilities; Idaho Falls, Idaho, USA (19 Aug 1975).

In Proceedings of the first conference on decontamination and decommissioning (D and D) of ERDA facilities.

A technique for deriving disposition criteria for the release and use of nuclear facilities has been developed. The criteria (1) are based on a consistent system of rationale, (2) give quantitative guidance on acceptable levels for release of nuclear facilities, (3) are applicable to all of the identified use restriction categories and (4) are adaptable to different types of nuclear facilities. Rationale for the derivation methodology and criteria acceptability standards are discussed. The derivation mechanism is developed and applied to a plutonium fuel fabrication facility. Present and future extension of the technique is indicated. (auth)

6375 (RDT-F—11-5T(5-75)) **Determination of fuel pellet homogeneity by alpha-autoradiography.** (Energy Research and Development Administration, Washington, D.C. (USA). Div. of Reactor Research and Development). May 1975. 13p. RSO.

This standard establishes the procedure for determining the homogeneity of plutonium oxide-uranium oxide (PuO_2-UO_2) fuel pellets by alpha-autoradiography. (auth)

6376 (UCRL—51928) **Evaluation of methods for seismic analysis of mixed-oxide fuel fabrication plants.** Tokarz, F.J.; Arthur, D.F.; Murray, R.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 8 Oct 1975. Contract W-7405-Eng-48. 64p. Dep. NTIS $5.45.

Guidelines are needed for selecting appropriate methods of structural analyses to evaluate the seismic hazard of mixed-oxide fuel fabrication plants. This study examines the different available methods and their applicability to fabrication plants. These results should provide a basis for establishing guidelines recommending methods of analysis to ensure safe design against seismic hazards. Using the Westinghouse Recycle Fuels Plant as representative of future mixed-oxide fuel fabrication plants, critical structures and equipment (systems, components, and piping/ducting) were identified. These included the manufacturing building and 11 different pieces of equipment. After examination of the dynamic response characteristics of the building and the different methods available to analyze equipment, appropriate methods of analyses were recommended. Because critical equipment analysis and test methods generally use floor-response spectra as their seismic input loading, several methods used to generate floor spectra were also

examined. These include the time-history approach and the Kapur and Biggs approximate methods. The examination included the effect of site characteristics and both horizontal and vertical structural response. (auth)

6377 Method of forming high density oxide pellets by hot pressing at 50° to 100°C above the cubic to monoclinic phase transformation temperature. Pasto, A.E. (to U.S. Energy Research and Development Administration). US Patent 3,898,309. 5 Aug 1975. Filed date 11 May 1973. 4p.

PAT-APPL-359,397.

A process for low temperature sintering of rare earth and actinide oxides which have a cubic to monoclinic transformation is described. The process involves hot pressing a powder compact at a temperature just above the transformation temperature. (auth)

6378 Process for surface treatment of zirconium-containing cladding materials for fuel element or other components for nuclear reactors. Videm, K.G.; Lunde, L.R.; Kooyman, H.H. (to Institutt for Atomenergi). US Patent 3,909,370. 30 Sep 1975. Filed date 30 Nov 1972. 12p.

A process for the surface treatment of zirconium-base cladding materials for fuel elements or other components for nuclear reactors is described. The treatment includes pickling the cladding material in a fluoride-containing bath, and then applying a protective coating through oxidation to the pickled cladding material. The fluoride-containing contaminants which remain on the surface of the cladding material during pickling are removed or rendered harmless by anodic oxidation. (auth)

SPENT FUELS REPROCESSING

6379 (CONF-750827—, pp 23-28) **Status of ANSI standards on decommissioning of nuclear reprocessing facilities.** Graham, H.B. (Holifield National Lab., Oak Ridge, TN). Sep 1975.

From Conference on decontamination and decommissioning of ERDA facilities; Idaho Falls, Idaho, USA (19 Aug 1975).

In Proceedings of the first conference on decontamination and decommissioning (D and D) of ERDA facilities.

A definition of decommissioning is given, and the preparation of ANSI Standard, "General Design Criteria for Nuclear Reprocessing Facilities" (N101.3) is discussed. A Eurochemic report, entitled "The Shutdown of Reprocessing Facilities—Results of Preliminary Studies on the Installations Belonging to Eurochemic," was used in the preparation of this standard. (LK)

6380 (CONF-750827—, pp 59-70) **Decontamination and decommissioning of licensed fuel reprocessing plants.** Chitwood, R.B. (Nuclear Regulatory Commission, Washington, DC). Sep 1975.

From Conference on decontamination and decommissioning of ERDA facilities; Idaho Falls, Idaho, USA (19 Aug 1975).

In Proceedings of the first conference on decontamination and decommissioning (D and D) of ERDA facilities.

Design criteria for decommissioning nuclear fuel reprocessing plants, decontamination experience, decommissioning alternatives, and disposal of radioactive wastes are considered. (LK)

6381 (CONF-750827—, pp 153-164) **Decontamination of a highly radioactive chemical processing facility.** Moore, P.R. (E.I. du Pont de Nemours and Co., Aiken, SC). Sep 1975.

From Conference on decontamination and decommissioning of ERDA facilities; Idaho Falls, Idaho, USA (19 Aug 1975).

In Proceedings of the first conference on decontamination and decommissioning (D and D) of ERDA facilities.

Five modules of the highly radioactively contaminated "hot canyon" in one of the chemical processing plants for irradiated fuel at Savannah River Plant were successfully decontaminated for installation of a new process. Decontamination was completed in about one year at a cost of about $150,000. The various techniques employed, equipment used, and the overall job plan are described. (auth)

6382 (GA-A—13278) **Dissolution of HTGR fuel.** Hutton, A.E. (General Atomic Co., San Diego, Calif. (USA)). 30 Sep 1975. Contract E(04-3)-167. vp. Dep. NTIS $10.60.

Status of the dissolution step for reprocessing the HTGR fuels from the Fort St. Vrain reactor is reported. The feasibility and desirability of (1) utilizing a batch 304L stainless steel dissolver and (2) boiling Thorex acid [13 M HNO_3/0.05 M HF/0.1 M $Al(NO_3)_3$] to dissolve HTGR fuel was established. Effects of variations in fuel physical properties and dissolver operating parameters on fuel dissolution rates were studied. As a result, it is also established that the dissolution rate of HTGR fuel is a function of the entire history of the fuel as well as of the operating parameters of the dissolver; i.e., HTGR fuel preparation and reprocessing methods can affect fuel particle size, density, etc., which in turn affect fuel dissolution rate. Even with this added complication, this study establishes a range of expected dissolution rates for a range of expected dissolver feeds. A quantitative measure of gas holdup and required air sparge rates is also presented. A theoretical dissolution model is developed and discussed. Several operating difficulties in the pilot plant dissolvers tested are disclosed; notably, (1) difficulties in obtaining representative solid samples (dissolver feed and insolubles) resulted in uncertainties in material balances, (2) difficulties in keeping purgerator dip tubes clear of solids resulted in uncertainties in specific gravity and level measurements. Both of these problems should be addressed in future development work. Other recommendations for future experimental testing related to HTGR fuel dissolution are presented and discussed. (auth)

6383 (GA-A—13552) **Differential leaching studies: HTGR fuel reprocessing development.** Wilbourn, R.G. (General Atomic Co., San Diego, Calif. (USA)). 1 Aug 1975. Contract E(04-3)-167. 21p. Dep. NTIS $4.00.

Differential leaching is defined as the ability to preferentially dissolve uranium from fissile particles rather than the bred uranium contained in fertile particles during HTGR fuel reprocessing. Thus, differential leaching offers a potential separation of parasitic ^{236}U from bred ^{233}U on a basis other than the difference between fissile and fertile particle size or density. Specifically, the solubility differences of U_3O_8, ThO_2, and mixed oxides in nitric acid form the basis for differential leaching. The application of differential leaching in various reprocessing flow sheets is considered. Data from previous and current investigations at General Atomic Company are presented. Some degree of separation of fertile particle ^{233}U from fissile particle ^{235}U and ^{236}U (separation factors 20 to 100) was obtained by treating simulated ash with nitric acid concentrations as low as 1 M. The success of any differential leaching flow sheet is strongly dependent on the irradiation exposure, Th/U ratio, fabrication technique, etc., of the material being leached. (auth)

6384 (GA-A—13593) **Thorium utilization program. Quarterly progress report for the period ending August 31, 1975.** (General Atomic Co., San Diego, Calif. (USA)). 30 Sep 1975. Contract E(04-3)-167. vp. Dep. NTIS $7.60.

This publication continues the quarterly series presenting results of work performed under the National HTGR Fuel Recycle Program (also known as the Thorium Utilization Program) at General Atomic Company. Results of work on this program prior to June 1974 were included in a quarterly series on the HTGR Base Program. The work reported includes the development of unit processes and equipment for reprocessing of High-Temperature Gas-Cooled Reactor (HTGR) fuel and the design and development of an integrated line to demonstrate the head end of HTGR reprocessing using unirradiated fuel materials. Work is also described on the evaluation of alternate techniques for fuel reprocessing to surmount possible operating problems with the reference flow sheet and the development of the conceptual design of a target recycle facility to identify the requirements of large-scale recycle of HTGR fuels. (auth)

6385 (HW—22076) **Laboratory demonstration of Redox feed head-end treatment: ruthenium volatilization and manganese dioxide scavenging.** Hicks, H.G.; McCormack, C.G.; Roake, W.E. (Hanford Works, Richland, Wash. (USA)). 15 Jul 1951. 60p. Dep. NTIS $5.50.

Declassified 14 Jul 1975.

The mechanics of manganese dioxide handling, laboratory development of manganese dioxide scavenging, and a series of experiments at multicurie level combining ruthenium volatilization and manganese dioxide scavenging in stainless steel equipment are dealt with.

6386 (ICP—1074) **Interim results: development of a head-end process for recovering uranium and thorium from crushed Fort St. Vrain fuel.** Hogg, G.W.; Rindfleisch, J.A.; Palmer, W.B.; Anderson, D.L.; Vavruska, J.S. (Allied Chemical Corp., Idaho Falls, Idaho (USA). Idaho Chemical Programs - Operations Office). Oct 1975. Contract E(10-1)-1375. 107p. Dep. NTIS $5.45.

Development of processes and equipment for recovering uranium and thorium from crushed Ft. St. Vrain fuel is described. Primary burning, particle classification, particle breaking, secondary burning, and aqueous processing were studied. Interim pilot-plant results show that: (1) graphite can be burned at the plant equivalent rate of 35 kgC/hr-ft^2 in the primary burner and that fines can be consumed by recycle to the primary burner; (2) separation to greater than 95 percent pure fissile and 85 percent pure fertile particles can be effected by a gas classifier; (3) gas jets are capable of breaking silicon carbide coatings at rates compati-

ble with plant requirements; gas utilization efficiencies are sufficiently great that off-gas generated by the jets is less than 5 percent of the off-gas generated by the process equipment; (4) an artificial inert bed is not required for secondary burning and the carbon content of the bed can easily be reduced to less than 2 percent in the secondary burner; (5) corrosion rates of thorex solution on 304 L stainless steel are sufficiently low to allow the dissolver to be constructed of 304 L stainless steel; and, (6) solids—liquid separation efficiencies using a continuous solid-bowl centrifuge are sufficiently high to process the dissolver product in a pulse-column extractor. Basic data on the process materials and conditions germane to the safety analysis for the process are also given. (JGB)

6387 (ORNL—5090) **Head-end reprocessing studies with irradiated HTGR-type fuels. III. Studies with RTE-7: TRISO UC_2-TRISO ThC_2.** Fitzgerald, C.L.; Vaughen, V.C.A.; Notz, K.J.; Lowrie, R.S. (Oak Ridge National Lab., Tenn. (USA)). Nov 1975. Contract W-7405-eng-26. 54p. Dep. NTIS $5.45.

Head-end reprocessing studies on irradiated Fort St. Vrain type HTGR fuel (TRISO coated UC_2-TRISO coated ThC_2) were performed. Fuel sticks were burned quiescently in oxygen at 750°C, the ash was screened to separate the fissile SiC-coated particles from the fertile SiC-coated particles, each particle fraction was crushed and burned separately in oxygen, and the secondary burner ash products were leached. These studies concentrated on the release of radionuclides to the burner off-gases after passing through a 20-μ m sintered metal frit held at 500°C. Fission product and heavy metal inventories were made on the process gaseous, liquid, and solid streams. Experimental results are compared with pre-irradiation average fuel stick compositions and with calculated fission product inventories. (auth)

6388 (ORNL-TM—4747) **Overview of HTGR fuel recycle.** Notz, K.J. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 56p. Dep. NTIS $5.50.

An overview of HTGR fuel recycle is presented, with emphasis placed on reprocessing and fuel kernel refabrication. Overall recycle operations include (1) shipment and storage, (2) reprocessing, (3) refabrication, (4) waste handling, and (5) accountability and safeguards. (auth)

6389 (ORNL-TM—4947) **Empirical model for calculating vapor-liquid equilibrium and associated phase enthalpy for the CO_2—O_2—Kr—Xe system for application to the KALC process.** Glass, R.W.; Gilliam, T.M.; Fowler, V.L. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 181p. Dep. NTIS $8.50.

An empirical model is presented for vapor-liquid equilibria and enthalpy for the CO_2-O_2 system. In the model, krypton and xenon in very low concentrations are combined with the CO_2-O_2 system, thereby representing the total system of primary interest in the High-Temperature Gas-Cooled Reactor program for removing krypton from off-gas generated during the reprocessing of spent fuel. Selected properties of the individual and combined components being considered are presented in the form of tables and empirical equations. (auth)

6390 (ORNL-TM—5059) **Characterization of effluents from a high-temperature gas-cooled reactor fuel refabrication plant.** Judd, M.S.; Bradley, R.A.; Olsen, A.R. (Oak Ridge National Lab., Tenn. (USA)). Dec 1975. Contract W-7405-eng-26. 50p. Dep. NTIS $5.50.

The types and quantities of chemical and radioactive effluents that would be released from a reference fuel refabrication facility for the High-Temperature Gas-Cooled Reactor (HTGR) have been determined. This information will be used to predict the impact of such a facility on the environment, to identify areas where additional development work needs to be done to further identify and quantify effluent streams, and to limit effluent release to the environment. (auth)

6391 (ORNL-TM—5096) **Characteristics of radioactive waste streams generated in HTGR fuel reprocessing.** Lin, K.H. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 38p. Dep. NTIS $5.00.

Results are presented of a study concerned with identification and characterization of radioactive waste streams from an HTGR fuel reprocessing plant. Approximate quantities of individual waste streams as well as pertinent characteristics of selected streams have been estimated. Most of the waste streams are unique to HTGR fuel reprocessing. However, waste streams from the solvent extraction system and from the plant facilities do not differ greatly from the corresponding LWR fuel reprocessing wastes. (auth)

WASTE MANAGEMENT

6392 (BNWL-B—439) **Aerosol measurements on a metal waste volume reduction study.** Sehmel, G.A.; Schwendiman, L.C.; Lloyd, F.A.; Hodgson, W.H. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Sep 1975. Contract E(45-1)-1830. 19p. Dep. NTIS $4.00.

Particulates generated in an experiment in which stainless steel scrap was melted by the exothermic reaction between silicon and oxygen were sampled. The objective of the sampling was to characterize the particles in the off-gas stream and to determine the total weight of particles airborne. The objective was only partially achieved since the mass of airborne particles was so large that full-flow sampling was possible only for a short period. The particles were analyzed and found to contain Si, Al, Na, and Ba, with Si representing the greatest component. The aerosol was characterized by being typically condensed fume with primary particles of submicron sizes. (auth)

6393 (CONF-750827—, pp 383-402) **Waste management and safety considerations for future LASL D and D projects.** Valentine, A.M.; Warren, J.L. (Los Alamos Scientific Lab., NM). Sep 1975.

From Conference on decontamination and decommissioning of ERDA facilities; Idaho Falls, Idaho, USA (19 Aug 1975).

In Proceedings of the first conference on decontamination and decommissioning (D and D) of ERDA facilities.

Currently excess contaminated facilities at the Los Alamos Scientific Laboratory are described along with associated Decontamination and Decommissioning waste management and safety considerations. Waste management and safety considerations are also briefly described for the removal and disposal of plutonium contaminated gloveboxes and equipment items in the LASL plutonium facility since the facility will be decontaminated when current operations are transferred to a new facility and for both past and future upgrading of the exhaust air filter system in a chemistry metallurgy research facility. (auth)

6394 **Other considerations in establishing standards.** Gamertsfeler, C.C. (Directorate of Regulatory Standards, Washington, DC). *Health Phys.*; **29**: No. 4, 563-568(Oct 1975).

From Proceedings of the second Los Alamos life sciences symposium; Los Alamos, NM, USA (22 May 1974).

The process of identifying as low as practicable guidelines on the release of radioactive material from nuclear facilities involves developing a thorough understanding of the capabilities and costs of potential radwaste systems, the definition of the quantities and kind of radioactive materials which would be expected in the effluents from these systems, as well as a knowledge of the ways these effluents are dispersed in the surface waters and atmosphere around the facility. From this information and a knowledge of the population distribution around the facility and the availability of appropriate dose models, the doses to individuals and the general population can be calculated, and potential risks due to these doses can be estimated. Cost-benefit relationships which identify the costs of population dose reductions and the potential future costs of the doses not eliminated provide a part of the information needed to make the necessary judgments. Other factors include the doses to individuals, the absolute magnitude of the costs, and other less tangible judgmental factors. (auth)

WASTE PROCESSING

6395 (BNWL—1945) **Pyrolysis: incineration of simulated combustible alpha wastes.** Mudge, L.K.; Schiefelbein, G.F.; Sullivan, R.G.; Walter, R.A. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Oct 1975. Contract E(45-1)-1830. 49p. Dep. NTIS $5.45.

Design, fabrication, and installation of a unit to demonstrate pyrolysis-incineration of simulated alpha wastes are described. The main reactor in the unit is a cylinder 7 ft long, lined with refractory in the lower $5^1/_2$ ft to give an effective inside diameter of about 11 in. Four experimental runs, using simulated alpha wastes, were completed. Average processing rates of 27 lb/hr were achieved. The waste components were shredded to an average size of 4 in. The ash content of the simulated waste was 3.6 wt percent. The composition of the off-gas from the process was determined using a gas chromatograph. Condensates (or tars) were collected during a 12-hr run and totaled 18 percent of the weight of the simulated feed that was processed. These tars had a calorific heating value of 9380 cal/g and a viscosity of 750 cp at 50 °C. Ash content of these tars was 0.3 wt percent. Ash collected during a 12-hr run appeared dark gray in color and had a bulk tap density of 0.76 g/cm³. The ash was found to contain 13 wt percent unburned carbon. This unburned material represents 0.5 wt percent of the waste treated in the process. For this particular waste composition and ash content, the volume reduction factor was 140. (auth)

6396 (CONF-750827—, pp 275-294) **Processing EBR-I NaK to produce a storable solid.** Hammer, R.R.; Lewis, L.C. (Allied Chemical Corp., Idaho Falls, ID). Sep 1975.

From Conference on decontamination and decommissioning of ERDA facilities; Idaho Falls, Idaho, USA (19 Aug 1975).

In Proceedings of the first conference on decontamination and decommissioning (D and D) of ERDA facilities.

Approximately 5500 gallons of fission product—contaminated liquid metal coolant (eutectic sodium—potassium alloy—NaK), was removed from the EBR-I reactor system, reacted with caustic solution to produce a solid 25 M potassium hydroxide—sodium hydroxide mixture suitable for storage at the Idaho National Engineering Laboratories RWMC. Considerations that went into the design and operation of the processing unit will be discussed. (auth)

6397 (GA-A—13708) **Waste management considerations in HTGR recycle operations.** Pence, D.T.; Shefcik, J.J.; Heath, C.A. (General Atomic Co., San Diego, Calif. (USA)). 7 Nov 1975. Contract E(04-3)-167. 17p. (CONF-751101—59). Dep. NTIS $4.50.

From Joint meeting of the American Nuclear Society and the Atomic Industrial Forum; San Francisco, California, USA (16 Nov 1975).

Waste management considerations in the recycle of HTGR fuel are different from those encountered in the recycle of LWR fuel. The types of waste associated with HTGR recycle operations are discussed, and treatment methods for some of the wastes are described. (LK)

6398 (ICP—1084) **DTA—x-ray evaluation of chemical reprocessing wastes.** Newby, B.J. (Allied Chemical Corp., Idaho Falls, Idaho (USA). Idaho Chemical Programs - Operations Office). Oct 1975. Contract E(10-1)-1375. 45p. Dep. NTIS $5.45.

Differential thermal analysis (DTA) and x-ray diffraction were used to generate DTA curves for defining the calcination chemistry significantly affecting particle agglomeration during solidification. For wastes containing sodium nitrate, DTA curves were interpreted to determine the effectiveness of additives in causing sodium nitrate (or sodium nitrate-nitrite) decomposition or conversion to stable compounds within the temperature range of fluidized-bed calcination. (auth)

6399 (ORNL-TM—5077) **Use of chemical equilibrium data to calculate Iodox column operations.** Mailen, J.C. (Oak Ridge National Lab., Tenn. (USA)). Dec 1975. Contract W-7405-eng-26. 19p. Dep. NTIS $5.00.

In an operation whose chemical mechanism is complicated, such as Iodox, prediction of the operation with changes in operating parameters can be difficult. Correlations of the decontamination factors of Iodox for iodine and CH_3I as functions of chemical equilibria are presented. Different equilibria appear to be involved where nitrogen oxides are absent in the gas stream and where considerable quantities of nitrogen oxides are present. Two separate correlations will be developed to cover these two cases. (auth)

6400 (SRO—525-8) **Separation of cations using permselective membrane systems and complexing agents.** Rush, W.E.; Kizer, J.D.; Baker, B.L. (Hoechst Fibers, Inc., Spartanburg, S.C. (USA); Dow Badische Co., Anderson, S.C. (USA); South Carolina Univ., Columbia (USA)). 31p. (CONF-751107—8). Dep. NTIS $4.75.

From 68. annual meeting of American Institute of Chemical Engineering; Los Angeles, California, USA (16 Nov 1975).

The effects of complexing and chelating agents on Donnan dialysis when using ion exchange membranes to separate and/or concentrate ions were studied. It was found that ions of like charge can be separated by the use of ion exchange membranes using chelating agents under the proper conditions of pH and flow rates. Experimental runs on the following ions are reported: Na, H, Mg, Ca, Zn, and Fe. Calculations showing the required conditions were made with results that are good estimates depending on how well the pH of the solutions was known. Separation of ions of the same charge can be described qualitatively by relating the separation of the ions to flow rates of the raffinate and extract streams. The methods described may be applicable to the removal and/or concentration of ions from waste streams or from dilute solutions in process applications. (auth)

WASTE DISPOSAL AND STORAGE

6401 (BNWL-SA—5581) **Expected behavior of HLW glass in storage.** McElroy, J.L. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1975. Contract E(45-1)-1830. 27p. (CONF-751075—1). Dep. NTIS $5.00.

From CNEN seminar on HLW conversion to glass; Policoro, Italy (14 Oct 1975).

Glass produced by solidification of high-level radioactive liquid waste is studied. Conditions to which the waste form will be exposed in a typical handling sequence representative of current U. S. planning are tabulated. The reference matrix for waste form characterization is discussed, and some of the properties of high-level waste glass are described: physical properties, leachability, fracturing, vaporization, and containment in canister. 12 fig, 5 tables (DLC)

6402 (CONF-750827—, pp 19-21) **ERDA safety practices involving disposal of contaminated real property.** Loop, E.K. (Energy Research and Development Administration, Washington, DC). Sep 1975.

From Conference on decontamination and decommissioning of ERDA facilities; Idaho Falls, Idaho, USA (19 Aug 1975).

In Proceedings of the first conference on decontamination and decommissioning (D and D) of ERDA facilities.

A general discussion of the specific procedures for excess disposal outlined in the Property Management Handbook, ERDAM 5301 is given. (LK)

6403 (CONF-750827—, pp 463-500) **Summary report of soil removal preliminary excavations.** Wickland, C.E. (Rockwell International, Golden, CO). Sep 1975.

From Conference on decontamination and decommissioning of ERDA facilities; Idaho Falls, Idaho, USA (19 Aug 1975).

In Proceedings of the first conference on decontamination and decommissioning (D and D) of ERDA facilities.

This report discusses a proposed technique to remove small areas, less than 2,000 m^2, of contaminated soil and the results of an actual excavation. Based on the results of a trial excavation in uncontaminated soil and an excavation of two trenches in contaminated soil, it is concluded that the techniques described are a satisfactory means of contaminated soil removal. It can be done safely with a release of airborne plutonium a factor of 10 or more below the Environmental Protection Administration (EPA) limit. (auth)

6404 (ORNL-TM—4333(Pt.1)) **Assessment of the loss of radioactive isotopes from waste solids to the environment. Part I. Background and theory.** Godbee, H.W.; Joy, D.S. (Oak Ridge National Lab., Tenn. (USA)). Feb 1974. Contract W-7405-eng-26. 65p. Dep. NTIS $4.50.

A report is given of several theoretical expressions based on mass transport phenomena that relate the radioactivity escaping from such solids to diffusion, dissolution processes, surface conditions, and radioactive decay. Representative available data for radioactive waste solids incorporated in cement, asphalt, ceramic, and glass media are analyzed using the theoretical expressions presented. These analyses show that an expression taking into account diffusion and concentration-dependent dissolution gives good agreement with the data for most of the products considered. In the main, these products can be categorized as waste solids of low solubility incorporated in inert matrices. The effective diffusivities obtained are in the range of mid 10^{-17} to mid 10^{-12} cm^2/sec, the dissolution rate constants are in the range of high 10^{-9} to low 10^{-7} sec^{-1}, and the surface transfer constants are in the range of low 10^{-4} to low 10^{-3} sec^{-1} for the products analyzed. Once determined, such parameters can be used to compare various waste products and to estimate releases from these products, in particular, long-term releases. (auth)

6405 (SAND—75-5656) **Sandia Laboratories environment and safety programs.** Zak, B.D.; McGrath, P.E.; Trauth, C.A. Jr. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1975. 13p. (CONF-750967—8). Dep. NTIS $4.00.

From 3. ERDA environmental protection conference; Chicago, Illinois, USA (23 Sep 1975).

Sandia, one of ERDA's largest laboratories, is primarily known for its extensive work in the nuclear weapons field. In recent years, however, Sandia's role has expanded to embrace sizeable programs in the energy, resource recovery, and the environment and safety fields. In this latter area, Sandia has programs which address nuclear, fossil fuel, and general environment and safety issues. Here we survey ongoing activities and describe in more detail aa few projects of particular interest. These range from a study of the impact of sealed disposal of radioactive wastes, through reactor safety and fossil fuel plume chemistry, to investigations of the composition and dynamics of the stratosphere. (auth)

6406 **Improved method for storage of solid waste.** Mecham, W.J. (to U.S. Energy Research and Development Administration). US Patent Application 548,058. Filed date 7 Feb 1975. 7p.

Metal canisters for long-term storage of calcined high-level radioactive wastes can be made self-sealing against a breach in the canister wall by the addition of powdered cement to the canister with the calcine before it is sealed for storage. Any breach in the

canister wall will permit entry of water which will mix with the cement and harden to form a concrete patch, thus sealing the opening in the wall of the canister and preventing the release of radioactive material to the cooling water or atmosphere. (auth)

6407 INTERIM STORAGE OF SOLIDIFIED HIGH-LEVEL RADIOACTIVE WASTES. Contract AT(11-1)-3053. Washington, DC; United States of America (USA); National Academy of Sciences (1975). 90p. (TID—27915). $8.50.

The feasibility, safety, and estimated costs of several concepts for the interim surface storage of solidified high-level radioactive wastes that result from the civilian nuclear power program were reviewed and evaluated. The panel concluded that, in principle, high-level wastes can be stored safely and economically in sealed storage casks,in a water basin, or in an air-cooled vault, but they recommend an optimized version of the sealed storage cask concept. (LK)

ENVIRONMENTAL ASPECTS

6408 (Y-DD—186) **Chromate abatement at the Oak Ridge Y-12 Plant.** Sanders, M. (Oak Ridge Y-12 Plant, Tenn. (USA)). 1975. Contract W-7405-eng-26. 23p. (CONF-750967—9). Dep. NTIS $4.25.

From 3. ERDA environmental protection conference; Chicago, Illinois, USA (23 Sep 1975).

A fifteen-month field study was completed that utilized four nonchromate based water treatment programs in the sixteen low temperature towers using corrosion and deposition studies, microbiological control, and plant effluent creek analyses as evaluation parameters. The study succeeded in reducing the levels of chromate in the plant effluent well below the limits established by the Environmental Protection Agency. (auth)

HEALTH AND SAFETY

6409 (CONF-750827—) **Proceedings of the conference on decontamination and decommissioning (D and D) of ERDA facilities, Idaho Falls, Idaho, August 19—21, 1975.** (Energy Research and Development Administration, Idaho Falls, Idaho (USA). Idaho Operations Office; Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). Sep 1975. 521p. Dep. NTIS $13.75.

From Conference on decontamination and decommissioning of ERDA facilities; Idaho Falls, Idaho, USA (19 Aug 1975).

Twenty-nine items have been abstracted separately for Nuclear Science Abstracts and ERDA Energy Research Abstracts. (LK)

6410 (CONF-750827—, pp 7-14) **Decontamination and decommissioning policy and programs.** Glauberman, H. (Energy Research and Development Administration, Washington, DC). Sep 1975.

From Conference on decontamination and decommissioning of ERDA facilities; Idaho Falls, Idaho, USA (19 Aug 1975).

In Proceedings of the first conference on decontamination and decommissioning (D and D) of ERDA facilities.

The policies, objectives, and the program structure for the management of surplus radioactively contaminated ERDA facilities are reviewed. (LK)

6411 (CONF-750827—, pp 501-508) **Disposal of personal property from ERDA facilities being decommissioned.** French, J.D. (Energy Research and Development Administration, Washington, DC). Sep 1975.

From Conference on decontamination and decommissioning of ERDA facilities; Idaho Falls, Idaho, USA (19 Aug 1975).

In Proceedings of the first conference on decontamination and decommissioning (D and D) of ERDA facilities.

Problem areas which should be considered early in planning the decommissioning of a facility are pointed out. (LK)

REGULATIONS

ACCOUNTABILITY AND SAFEGUARDS

6412 (SAND—75-6061) **Fixed-site physical protection system modeling.** Chapman, L.D. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1975. 15p. (CONF-751203—1). Dep. NTIS $4.50.

From Winter computer simulation conference; Sacramento, California, USA (18 Dec 1975).

An evaluation of a fixed-site safeguard security system must consider the interrelationships of barriers, alarms, on-site and off-site guards, and their effectiveness against a forcible adversary attack whose intention is to create an act of sabotage or theft. A computer model has been developed at Sandia Laboratories for the evaluation of alternative fixed-site security systems. Trade-offs involving on-site and off-site response forces and response times, perimeter alarm systems, barrier configurations, and varying levels of threat can be analyzed. The computer model provides a framework for performing inexpensive experiments on fixed-site security systems for testing alternative decisions, and for determining the relative cost effectiveness associated with these decision policies. (auth)

6413 (SAND—75-6156) **[Safeguards for the physical protection of nuclear materials and facilities].** Jones, O.E. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1975. 10p. (CONF-751124—1). Dep. NTIS $4.00.

From Assembly committee on resources, land use, and energy; Sacramento, California, USA (18 Nov 1975).

Testimony is given on the subject of safeguards for the physical protection of nuclear materials and facilities, particularly during transportation. The ERDA nation-wide safe-secure transportation system and the Safe-Secure Trailer are described. The nationwide ERDA voice communication system is also described. Development of hardware and systems is discussed. The use of adversary simulation for evaluating protection systems is mentioned. (DLC)

6414 (SAND—75-6190) **Security force-adversary engagement simulation.** Bennett, H.A. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1975. 22p. (CONF-751203—2). Dep. NTIS $4.50.

From Winter computer simulation conference; Sacramento, California, USA (18 Dec 1975).

A dynamic simulation of a security force-adversary engagement has been developed to obtain a better understanding of the complexities involved in security systems. Factors affecting engagement outcomes were identified and interrelated to represent an ambush of an escorted nuclear fuel truck convoy by an adversary group. Other forms of engagement such as assault and skirmish also can be simulated through suitable parameter changes. The dynamic model can provide a relative evaluation of changes in security force levels, equipment, training, and tactics. Continued application and subsequent refinements of the model are expected to augment the understanding of component interaction within a guard-based security system. (auth)

6415 Some statistical aspects of bias corrections. Stewart, K.B. (Battelle Pacific Northwest Labs., Richland, WA). *Nucl. Mater. Manage.;* **4**: No. 2, 20-25(Sum 1975).

An important practical question is whether bias corrections should always be made to a measurement process or should be made only when a test of the measurements of a standard indicates a statistically significant, nonzero bias. Some statistical aspects of this question are studied. Results are expressed in comparative terms, as ratios of mean-square deviations for the two procedures. It is assumed that the standard deviations involved with the measurement process and the standard are known. (auth)

6416 Some thoughts on bias corrections. Jaech, J.L. (Exxon Nuclear Co., Inc., Richland, WA). *Nucl. Mater. Manage.;* **4**: No. 2, 40-44(Sum 1975).

Two key questions on bias corrections in SNM accountability are: (1) when should bias corrections be made, and (2) how may the uncertainty associated with the resulting data be expressed. This paper presents some discussion and results that may be of value in finding answers to these questions. (DLC)

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

PHYSICAL ISOTOPE SEPARATION

6417 Extraction electrode geometry for a calutron. Veach, A.M.; Bell, W.A. Jr. (to U.S. Energy Research and Development Administration). US Patent 3,908,123. 23 Sep 1975. Filed date 16 Apr 1974. 6p.

PAT-APPL-461,472.

This patent relates to an improved geometry for the extraction electrode and the ground electrode utilized in the operation of a calutron. The improved electrodes are constructed in a partial-picture-frame fashion with the slits of both electrodes formed by two tungsten elongated rods. Additional parallel spaced-apart rods in each electrode are used to establish equipotential surfaces over the rest of the front of the ion source. (auth)

ISOTOPIC POWER SUPPLIES

6418 (BNWL—1845-14) **Pacific Northwest Laboratory quarterly report to Advanced Nuclear Energy Systems, Space and Special Purposes Division.** Jarrett, J.H.; Harmon, K.M. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 30 Jun 1975. Contract E(45-1)-1830. 16p. Dep. NTIS $4.00.

Progress during the fourth quarter of FY-1975 in research on the utilization of nuclear by-products is reported. Preliminary conceptual and engineering analysis studies were made of a proposed U.S. Air Force 2kW(e) power system employing Waste Encapsulation and Storage Facility (WESF) $^{90}SrF_2$ capsules as a source of heat. The results showed the feasibility of such a system, but indicated that the SrF_2 capsule materials might have to be changed to satisfy operating life requirements. Dose rates from a WESF $^{90}SrF_2$ capsule were measured. Dose rates and radiation efficiences for WESF $^{137}CsCl$ capsules of varying geometries were calculated. A forecast of the potential supply of a number of beneficial reactor by-products was assembled. A start was made on the definitions of a flow sheet for an integrated reactor by-product recovery plant. Preliminary work was done on the methodology for forecasting long-term demand for reactor by-products. (auth)

6419 (BNWL—1845-16) **Pacific Northwest Laboratory quarterly report to USERDA Advanced Nuclear Energy Systems, Space and Special Purposes Division, for July—September 1975.** Fullam, H.T.; Harmon, K.M. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Oct 1975. Contract E(45-1)-1830. 20p. Dep. NTIS $4.00.

Progress during July to October 1975 in research on radioisotope heat sources is reported. The design of the long-term $^{90}SrF_2$ compatibility tests has been finalized. The effect of thermal aging on the impact strength of Hastelloy C-4 is being evaluated using Charpy test specimens. The solubility of SrF_2 in seawater and demineralized water was determined at 23°C. The equilibrium concentration of Sr in demineralized water is greatly influenced by the presence of fluoride impurities in the SrF_2, whereas in seawater the presence of fluoride impurities has little effect on the Sr concentration. The effect of impurity fluorides and decay product (ZrF_4) on the melting point of SrF_2 was determined using differential thermal analysis. The lowest melting point observed in the system containing SrF_2, ZrF_4 and impurity fluorides found in WESF $^{90}SrF_2$ was 851 +- 5°C. Two reports on potential applications of isotopes were prepared, and theoretical work continued on the effect of source geometry on the radiation efficiency of $^{137}CsCl$ capsules. (LCL)

6420 (JPL—4) **Program of thermoelectric generator testing and RTG degradation mechanisms evaluation. Progress report No. 14.** (Jet Propulsion Lab., Pasadena, Calif. (USA)). Nov 1975. Contract AT(04-3)-959. 58p. Dep. NTIS $5.50.

Progress during September and October 1975 in the development and evaluation of thermoelectric generators for use with radioisotope heat sources is reported. Information is included on the operation of Si_3N_4-coated SiGe legs in vacuum and in CO; selenide material evaluation tests; and the performance testing of thermoelectric generators representing SiGe and PbTe advanced technology. (LCL)

DESIGN AND FABRICATION

6421 (BNWL—1845-17) **Pacific Northwest Laboratory monthly report to Advanced Nuclear Energy Systems, Space and Special Purposes Division, for October 1975.** Fullam, H.T. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Nov 1975. Contract E(45-1)-1830. 8p. Dep. NTIS $4.00.

At Hanford, strontium will be separated from the high-level waste, then converted to the fluoride, and doubly encapsulated in small, high-integrity containers for subsequent long-term storage. The fluoride conversion, encapsulation and storage will take place in the Waste Encapsulation and Storage Facilities (WESF). This encapsulated strontium fluoride represents an economical source of ^{90}Sr if the WESF capsule can be licensed for heat source applications under anticipated use conditions. The objectives of this program are to obtain the data needed to license $^{90}SrF_2$ heat sources and specifically the WESF $^{90}SrF_2$ capsules. The information needed for licensing can be divided into three general areas: long-term SrF_2 compatibility data; chemical and physical property data on $^{90}SrF_2$; and capsule property data such as external corrosion resistance, crush strength, etc. The current program is designed to provide the required information. (auth)

6422 (DPST—75-128-10) **^{238}Pu fuel form processes. Savannah River Laboratory monthly report.** (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Lab.). Oct 1975. Contract AT(07-2)-1. 51p. Dep NTIS $4.50.

Characterization studies of HB-Line production $^{238}PuO_2$ have shown that (1) mode size can now be predicted to within 0.5 μm (the empirical equation relating processing parameters to particle size was refined and is currently based on 19 laboratory precipitations)) and (2) the HB-Line can generally control the mode size of $^{238}PuO_2$ within 0.5 μm . In studies of alternative precipitation techniques, the following items were observed: (1) increasing the precipitation temperature increases the particle size and decreases agglomeration, (2) the type of agglomeration formed during precipitation is a function of the initial supersaturation (at low supersaturation, rosettes are formed; at high supersaturation, loose agglomerates are formed; and at intermediate levels of supersaturation, spherulites are formed), and (3) two alternative techniques, Pu(IV) reverse strike and Pu(III) reverse strike at high plutonium concentrations, show promise for producing powders that may be hot pressed directly into fuel forms. Pellets hot pressed from LASL shards show that increasing the pressure from 3000 to 5000 psi during hot pressing has a greater effect on pellet density than does decreasing the shard heat-treatment temperature from 1150 to 1050°C. The thermal conductivity of theoretically dense $^{238}PuO_2$ was calculated, and conductivities for $^{238}PuO_2$ powders and shards in air, argon, and helium were measured. (auth)

6423 **Radioisotopic heat source.** Jones, G.J.; Selle, J.E.; Teaney, P.E. (to U.S. Energy Research and Development Administration). US Patent 3,909,617. 30 Sep 1975. Filed date 30 May 1974. 8p.

PAT-APPL-474,548.

Disclosed is a radioisotopic heat source and method for a long life electrical generator. The source includes plutonium dioxide shards and yttrium or hafnium in a container of tantalum-tungsten-hafnium alloy, all being in a nickel alloy outer container, and subjected to heat treatment of from about 1570°F to about 1720°F for about one h. (auth)

HYDROGEN

6424 **HYDROGEN ENERGY. PART A. HYDROGEN ECONOMY MIAMI ENERGY CONFERENCE, MIAMI BEACH, FLORIDA, MARCH 18—20, 1974.** Veziroglu, T.N. (ed.). New York; United States of America (USA); Plenum Publishing Corporation (1975). 715p. (CONF-740306—PA).

From Hydrogen economy Miami energy conference; Miami Beach, Florida, USA (18 Mar 1974).

Forty-five papers presented at the THEME conference have been abstracted separately. Two items have been announced in both Nuclear Science Abstracts and ERDA Energy Research Abstracts and forty-four have been announced in ERDA Energy Research Abstracts. (LK)

6425 **Social and environmental context of the hydrogen economy.** Salmon, J.D. (Virginia Polytechnic Inst. and State Univ., Blacksburg); Witwer, J.G. pp 1123-1135 of In Hydrogen energy. Part B. Veziroglu, T.N. (ed.). New York; Plenum Publishing Corp. (1975).

From Hydrogen economy Miami energy conference; Miami Beach, Florida, USA (18 Mar 1974).

See CONF-740306—PB.

A hydrogen energy study conducted by the 1973 NASA/ASEE Engineering Systems Design Institute at the Johnson Space Center utilized interdisciplinary teams to identify social-level impacts of the hydrogen economy. Some of the findings and some extensions of that work are presented. A matrix evaluation scheme was used so that informed judgment could be directed to the social impacts of hydrogen by combining social and technical considerations. These results provide background for some implementation scenarios. (auth)

6426 **How might the hydrogen economy affect our resources and environment.** Plass, H.J. Jr. (Univ. of Miami, Coral Gables, FL). pp 1157-1176 of In Hydrogen energy. Part B. Veziroglu, T.N. (ed.). New York; Plenum Publishing Corp. (1975).

From Hydrogen economy Miami energy conference; Miami Beach, Florida, USA (18 Mar 1974).

See CONF-740306—PB.

Several systems for the production, distribution and utilization of hydrogen are compared with corresponding systems not using hydrogen, but having the same energy resource base. For the systems being compared, estimates are made of rates of consumption of energy resources, and of the forms and extent of environmental damage resulting from the use of the particular system. Except for solar energy, the resource depletion rates and environ-

mental costs of hydrogen systems are greater than those of their non-hydrogen counterparts. (auth)

6427 Carbon dioxide problem. Jones, L.W. (Univ. of Michigan, Ann Arbor). pp 1177-1179 of In Hydrogen energy. Part B. Veziroglu, T.N. (ed.). New York; Plenum Publishing Corp. (1975).

From Hydrogen economy Miami energy conference; Miami Beach, Florida, USA (18 Mar 1974).

See CONF-740306—PB.

It is shown that reliance on fossil fuels for our future energy needs will lead to a significant buildup in atmospheric carbon dioxide. As it is believed that CO_2 is a significant factor in regulating the earth's heat balance, such a buildup may be a cause for concern. (auth)

6428 Energy crises. Schulman, F. (Fred Schulman Associates, Silver Spring, MD). pp 1181-1192 of In Hydrogen energy. Part B. Veziroglu, T.N. (ed.). New York; Plenum Publishing Corp. (1975).

From Hydrogen economy Miami energy conference; Miami Beach, Florida, USA (18 Mar 1974).

See CONF-740306—PB.

The energy crises facing America involve complex technical environmental, political, financial, tax, and diplomatic aspects. Some of these interrelationships are covered as they relate to (1) the nature of the oil crisis and how we got into it; (2) the Arab oil weapon and its effects on us; (3) what we can do about it--both short and long term; (4) effects on foreign relations; and (5) the Soviet role in this complex situation. Determined action can overcome our current and future energy crises. (auth)

6429 Technical problems facing the hydrogen economy. Gregory, D.P. (Inst. of Gas Tech., Chicago). pp 1209-1217 of In Hydrogen energy. Part B. Veziroglu, T.N. (ed.). New York; Plenum Publishing Corp. (1975).

From Hydrogen economy Miami energy conference; Miami Beach, Florida, USA (18 Mar 1974).

See CONF-740306—PB.

The concept of a Hydrogen Economy conjures up a picture in which the major part of our energy transmission and utilization system is dominated by hydrogen fuel. At present, there is no commercial use of pure hydrogen as a fuel gas, and for very good primarily economic reasons. This paper is concerned with some of the technological problems that appear to stand in the way of instituting a dramatic changeover to this new fuel. It discusses some of the problems that have to be solved before we can develop a commercial hydrogen energy economy. The problems include technical, economic, and institutional, or policy, problems. They are not insurmountable, provided a rational approach is made to solving them. After discussing the nature of the problems, a program and time scale for long-range hydrogen technology research will be outlined. (auth)

6430 Hydrogen economy and the law. Cady, T.C. (West Virginia Univ., Morgantown). pp 1219-1238 of In Hydrogen energy. Part B. Veziroglu, T.N. (ed.). New York; Plenum Publishing Corp. (1975).

From Hydrogen economy Miami energy conference; Miami Beach, Florida, USA (18 Mar 1974).

See CONF-740306—PB.

The current energy crisis is not simply a technological problem requiring technological solution. It is also, among many others a legal problem. A shift to a Hydrogen Economy would require considerable legal adjustment, particularly in the energy, environmental, and international areas. In short, a Hydrogen Economy does present legal problems, but none equivalent to a technological impossibility. The law is flexible and can be adjusted. (auth)

6431 Engineering assessment of the hydrogen economy. Mingle, J.O. (Kansas State Univ., Manhattan); Eckhoff, N.D.; Rash, L.A. pp 1239-1249 of In Hydrogen energy. Part B. Veziroglu, T.N. (ed.). New York; Plenum Publishing Corp. (1975).

From Hydrogen economy Miami energy conference; Miami Beach, Florida, USA (18 Mar 1974).

See CONF-740306—PB.

An assessment is made of the feasibility of meeting production and storage requirements for a hydrogen economy encompassing the East Coast of the United States. The timing of engineering facilities sufficient to insure adequate hydrogen production and distribution is shown to be critical. The manpower requirements are shown to place an extreme burden on the projected engineering resources. (auth)

6432 Ultimate energy, the ultimate fuel, and the hydrogen link in the electical energy system. Summers, C.M. (Univ. of Kansas, Lawrence). pp 1251-1264 of In Hydrogen energy. Part B. Veziroglu, T.N. (ed.). New York; Plenum Publishing Corp. (1975).

From Hydrogen economy Miami energy conference; Miami Beach, Florida, USA (18 Mar 1974).

See CONF-740306—PB.

Some of the long-range potential solutions for the energy dilemma are considered. An estimate is given for the ultimate energy we can tolerate in the United States; the ultimate source of energy is discussed; hydrogen is suggested as the ultimate fuel and as an important link in our electrical energy system; and some thoughts are given regarding national and state energy objectives. (auth)

6433 Dynamics of a universal hydrogen fuel system. Veziroglu, T.N.; Basar, O. (Univ. of Miami, Coral Gables, FL). pp 1287-1326 of In Hydrogen energy. Part B. Veziroglu, T.N. (ed.). New York; Plenum Publishing Corp. (1975).

From Hydrogen economy Miami energy conference; Miami Beach, Florida, USA (18 Mar 1974).

See CONF-740306—PB.

As an answer to the problems of growing fuel demand, pollution and the depletion of fossil fuels, the replacement of fossil fuels by hydrogen has been investigated. It has been shown that this could be a solution for the above problems, and that the world parameters, such as pollution, fuel consumption and gross product, could tend towards equilibrium values. (auth)

PRODUCTION

6434 Hydrogen: the ultimate energy source. Hirschberg, J.G. (Univ. of Miami, Coral Gables, FL). pp 107-111 of In Hydrogen energy. Part A. Veziroglu, T.N. (ed.). New York; Plenum Publishing Corp. (1975).

From Hydrogen economy Miami energy conference; Miami Beach, Florida, USA (18 Mar 1974).

See CONF-740306—PA.

Nuclear fusion of hydrogen provides an attractive source of energy for the Hydrogen Economy. There is plenty of raw material: the oceans and lakes of the world can supply enough heavy hydrogen to satisfy our present needs for countless millenia to come. The process is clean; the only lasting product is inert helium. The exploration of possible methods to unlock this source of energy spans 30 years and as many countries. A solution of this, perhaps the central technological problem of our time, remains elusive, although we are apparently approaching it. (auth)

ELECTROLYSIS

6435 (BNL—20590) **Hydrogen production, storage, and conversion for electric utility and transportation applications.** Srinivasan, S.; Wiswall, R.H. (Brookhaven National Lab., Upton, N.Y. (USA)). Oct 1975. 28p. Dep. NTIS $4.00.

Hydrogen is a promising fuel of the future, particularly for electric utility and transportation applications. An essential requirement in both these applications is the necessity for optimizing the intermediate steps of hydrogen production, its storage and conversion from the point of view of capital cost, energy utilization, and energy conversion efficiency. At the present time, the energy efficiency for hydrogen production by water electrolysis is about 75%. With improved catalysts, higher operating temperatures and better separator materials in advanced systems (Teledyne, Lurgi, and General Electric water electrolyzers), it should be possible to carry out water electrolysis at close to 100% efficiencies. The storage of hydrogen as a metal hydride shows significant advantages over the cryogenic or compressed gas procedures. For electric utility applications, its feasibility has been demonstrated using an iron-titanium alloy. Though this alloy may also be suitable for hydrogen storage in buses and trains, it will be necessary to consider the lighter hydrides for automobiles. With fuel cells or combined cycle gas turbines, it should be possible to attain energy conversion efficiencies of about 60%. The present status and potential for improvements in acid, alkaline, molten carbonate, and solid oxide fuel cell systems are briefly summarized. (auth)

6436 Hydrogen energy systems as to be applied in Japan and the key technologies. Ohta, T. (Yokohama National Univ., Japan). pp 1279-1285 of In Hydrogen energy. Part B. Veziroglu, T.N. (ed.). New York; Plenum Publishing Corp. (1975).

From Hydrogen economy Miami energy conference; Miami Beach, Florida, USA (18 Mar 1974).

See CONF-740306—PB.

Two systems and the key technologies are proposed. The first is that the reactor or the solar furnace on the coasts generates

hydrogen and then electric power by the surplus heat of the preceding process, and vice versa. The second is that the large rafts on the equatorial sea produce hydrogen from seawater by solar energy. The key methods by chemical cycles and by thermoelectricity are discussed. (auth)

STORAGE

6437 Role of hydrogen in electric energy storage. Salzano, F.J.; Cherniavsky, E.A.; Isler, R.J.; Hoffman, K.C. (Brookhaven National Lab., Upton, NY). pp 915-932 of In Hydrogen energy. Part B. Veziroglu, T.N. (ed.). New York; Plenum Publishing Corp. (1975).

From Hydrogen economy Miami energy conference; Miami Beach, Florida, USA (18 Mar 1974).

See CONF-740306—PB.

Electricity must be provided by the utilities on demand which varies daily, weekly, and in a seasonal cycle. This results in the under utilization of high capital cost generating facilities and the reliance on peaking devices such as gas turbines and pumped storage. Gas turbine generators, though presently economical, are highly inefficient and use high grade liquid or gaseous fossil fuels which may eventually be in short supply. The role of electric storage in utility systems is discussed. The technology of hydrogen production, storage, and reconversion to electricity as a technique for electric energy storage is discussed and shown by means of an optimization model to fit well into the United States energy system. (auth)

6438 Hydrogen-energy storage for electrical utility systems. Kippenhan, C.J.; Corlett, R.C. (Univ. of Washington, Seattle). pp 933-947 of In Hydrogen energy. Part B. Veziroglu, T.N. (ed.). New York; Plenum Publishing Corp. (1975).

From Hydrogen economy Miami energy conference; Miami Beach, Florida, USA (18 Mar 1974).

See CONF-740306—PB.

Hydrogen-energy is considered for storage of temporarily surplus electric energy. This severely constrained hydrogen application would be relatively easy to establish, even if economically marginal, and could be a valuable step towards more complex hydrogen-energy systems. Electrolysis, storage and handling, and fuel cell recombination are considered with respect to both capital cost and losses of useful energy. State-of-the-art technology would not produce even a marginally competitive system, but development realistic to a ten-year time frame might do so. (auth)

6439 Economic study of electrical peaking alternatives. Parrish, W.R. (National Bureau of Standards, Boulder, CO). pp 949-968 of In Hydrogen energy. Part B. Veziroglu, T.N. (ed.). New York; Plenum Publishing Corp. (1975).

From Hydrogen economy Miami energy conference; Miami Beach, Florida, USA (18 Mar 1974).

See CONF-740306—PB.

Results are given of a feasibility study of alternatives for producing peak power. Fuel cells, batteries, and superconducting magnetic storage are considered as well as gas turbines and pumped storage. The fuels considered are hydrogen, from coal or electrolysis, synthetic natural gas, and methanol. Fuel storage alternatives include liquid, compressed gas, and for hydrogen, metallic hydride. (auth)

CHEMISORPTION

6440 Metal hydrides: experimental methods and application to vehicular propulsion. Jonville, P.; Stohr, H.; Funk, R.; Kornmann, M. (Battelle Memorial Inst., Geneva). pp 765-778 of In Hydrogen energy. Part B. Veziroglu, T.N. (ed.). New York; Plenum Publishing Corp. (1975).

From Hydrogen economy Miami energy conference; Miami Beach, Florida, USA (18 Mar 1974).

See CONF-740306—PB.

Experimental methods to determine important properties of hydrides are described. Special attention is given to CPI-measurements, isobaric and constant composition devices as well as to the combined DTA-GC-method. Some experimental results such as alloying effects, reversibility and activation of Ti- and Zr-alloys with Cu, Mn and Ni are presented. Among other applications, the storage of hydrogen for an urban vehicle is of outstanding interest. Analysis of pressure and temperature requirements shows that for starting purposes an auxiliary tank would be necessary for both the IC- and fuel cell-driven vehicle. (auth)

6441 Application of metal hydrides to ground transport. Waide, C.H.; Reilly, J.J.; Wiswall, R.H. (Brookhaven National Lab., Upton, NY). pp 779-790 of In Hydrogen energy. Part B. Veziroglu, T.N. (ed.). New York; Plenum Publishing Corp. (1975).

From Hydrogen economy Miami energy conference; Miami Beach, Florida, USA (18 Mar 1974).

See CONF-740306—PB.

Hydrogen, an alternative to gasoline fuel in vehicle applications, can be stored as a metal hydride and released for use by the application of waste heat from the engine. Present investigations include a review of known and possible hydrides with a potential for automotive use. Hydride bed types and their application to vehicles are discussed. Two hydrides are considered. Their merits and potential for use in meeting various transportation needs are discussed. Implementation through fleet vehicle systems is proposed as a means of gaining practical experience with reasonable control during the introduction of the advanced technology. (auth)

6442 Hydrogen storage in automobiles using cryogenics and metal hydrides. Billings, R.E. (Billings Energy Research Corp., Provo, UT). pp 791-801 of In Hydrogen energy. Part B. Veziroglu, T.N. (ed.). New York; Plenum Publishing Corp. (1975).

From Hydrogen economy Miami energy conference; Miami Beach, Florida, USA (18 Mar 1974).

See CONF-740306—PB.

The world energy crisis, coupled with the pressing need to reduce air pollution, has placed important emphasis on developing new fuel sources for transportation systems. Hydrogen, with its almost unlimited supply potential and with its extraordinarily clean combustion properties, emerges as an operationally practical, economically feasible energy source. Cryogenic and metal hydride storage systems offer considerable promise to hydrogen as a significant fuel for automobiles and other modes of transportation. (auth)

6443 Dynamics of energy and mass transfer with reaction in hydride storage systems. Powers, G.J.; Cummings, D.L. (Massachusetts Inst. of Tech., Cambridge). pp 803-817 of In Hydrogen energy. Part B. Veziroglu, T.N. (ed.). New York; Plenum Publishing Corp. (1975).

From Hydrogen economy Miami energy conference; Miami Beach, Florida, USA (18 Mar 1974).

See CONF-740306—PB.

An investigation into the applications of metal hydrides has been carried out. Metal hydrides offer a reversible, chemical means for storing and supplying hydrogen and could be used as mobile and stationary fuel sources. For a specific hydride bed design, a model was developed which treats the processes in the bed as a phase-change heat transfer problem. A computer program was developed to simulate the dynamic response of a bed of magnesium hydride when used in an automobile. (auth)

TRANSPORT

6444 Hydrogen as an energy carrier. Murray, R.G. (Oklahoma State Univ., Stillwater). pp 901-914 of In Hydrogen energy. Part B. Veziroglu, T.N. (ed.). New York; Plenum Publishing Corp. (1975).

From Hydrogen economy Miami energy conference; Miami Beach, Florida, USA (18 Mar 1974).

See CONF-740306—PB.

The findings of the 1973 NASA/ASEE Summer Faculty Design Team are summarized as these findings apply to the usages of hydrogen as an energy carrier. The Team used a systems-analysis approach throughout the study to provide unbiased results concerning the feasibility of using hydrogen in the various segments of society. After establishing energy use patterns and projected future demand patterns (omitted from this paper for brevity), a feasibility profile for hydrogen usage was established. This profile first examined the capability of various devices to use the fuel, hydrogen. Consideration was given to both practical and research devices for present worth as well as future possibility. The profile also examined the utilization of each appropriate device in the five major use areas. (1) Industrial-chemical, (2) Industrial-fuel, (3) Transportation, (4) Residential and commercial, and (5)Electric power generation. Safety and environmental considerations were also examined. (auth)

MARKETING AND ECONOMICS

6445 Hydrogen: mechanisms and strategies of market penetration. Manne, A.S.; Marchetti, C. (International Inst. for Applied Systems Analysis, Laxenburg, Austria). pp 1193-1208 of In Hydrogen energy. Part B. Veziroglu, T.N. (ed.). New York; Plenum Publishing Corp. (1975).

From Hydrogen economy Miami energy conference; Miami Beach, Florida, USA (18 Mar 1974).

See CONF-740306—PB.

The time seems appropriate for assessing the economic potential of hydrogen in the energy game and for estimating the discounted value of this potential. We need quantitative estimates of the time lags, probabilities of success and the costs of R and D in order to provide guidelines for the allocation of the substantial sums of money that will be needed for a successful and timely development program. Two successive models are described--one for quantifying the benefits and the other for optimizing the level and the structure of the research effort. These models require numerical values for certain parameters, and in each case we have attempted to work with prudent estimates. Because of the inherently subjective nature of these parameters, we have run a series of sensitivity analyses. In all cases--even with the most pessimistic assumptions concerning a non-growing, slow-learning society--the prospective benefits appear high. (auth)

INDUSTRIAL AND COMMERCIAL USE

6446 Engine performance with gasoline and hydrogen: a comparative study. Finegold, J.B.; Van Vorst, W.D. (Univ. of California, Los Angeles). pp 685-696 of In Hydrogen energy. Part B. Veziroglu, T.N. (ed.). New York; Plenum Publishing Corp. (1975).

From Hydrogen economy Miami energy conference; Miami Beach, Florida, USA (18 Mar 1974).

See CONF-740306—PB.

An experimental investigation of the performance of an internal combustion engine on hydrogen as compared to gasoline has been carried out. The minimal modifications necessary for operation on hydrogen are discussed. Operation with hydrogen resulted in an increase in brake thermal efficiency of from 25 to 100% over that obtained with gasoline, while oxides of nitrogen emissions were reduced 90 to 97%. Some form of charge dilution is essential when operating with hydrogen at high power output, and the spark plug gap should be set significantly narrower. (auth)

6447 Backfire control techniques for hydrogen fueled internal combustion engines. Lynch, F.E. (Billings Energy Research Corp., Provo, UT). pp 717-726 of In Hydrogen energy. Part B. Veziroglu, T.N. (ed.). New York; Plenum Publishing Corp. (1975).

From Hydrogen economy Miami energy conference; Miami Beach, Florida, USA (18 Mar 1974).

See CONF-740306—PB.

The commonly cited causes of backfires, such as hot spots caused by preignition, are inadequate to explain backfires under many circumstances. A viable hypothesis is formed through consideration of high-temperature particulate matter in the residual cylinder gases. Various methods for controlling backfires are surveyed from the viewpoint of thermal explosion theory. Some novel engine constructions, which are effective in suppressing backfires, are offered in support of a residual gas quenching technique. (auth)

6448 Hydrogen and methanol fueled—air breathing automobile engine. Adt, R.R. Jr.; Greenwell, H.; Swain, M.R. (Univ. of Miami, Coral Gables, FL). pp 727-738 of In Hydrogen energy. Part B. Veziroglu, T.N. (ed.). New York; Plenum Publishing Corp. (1975).

From Hydrogen economy Miami energy conference; Miami Beach, Florida, USA (18 Mar 1974).

See CONF-740306—PB.

Both hydrogen and methanol have been proposed as synthetic fuels of the future. Recently it has been demonstrated that a conventional piston type Otto cycle engine can be operated in an unthrottled mode using the Hydrogen Induction Technique (HIT). The results obtained when the HIT engine is fueled with a methanol air mixture are presented. Data for brake thermal efficiency and nitric oxide production are compared with that obtained for the engine fueled by hydrogen. Also included are hydrocarbon and carbon monoxide emission levels measured during the methanol tests. Methanol can be used at lean mixtures where the efficiency is high and emission levels low. (auth)

6449 Use of personal vehicles within the hydrogen energy economy: an assessment. Dickson, E.M.; Logothetti, T.J.; Ryan, J.W.; Weisbecker, L.W. (Stanford Research Inst., Menlo Park, CA). pp 739-753 of In Hydrogen energy. Part B. Veziroglu, T.N. (ed.). New York; Plenum Publishing Corp. (1975).

From Hydrogen economy Miami energy conference; Miami Beach, Florida, USA (18 Mar 1974).

See CONF-740306—PB.

Hydrogen used to fuel private automobiles is compared to other options. Compatibility with existing fuel or energy distribution networks is a key consideration. Because these networks are technically and institutionally resistant to change, options which require only evolutionary rather than fundamental change are more practical. Hydrogen is less compatible with existing networks than other alternatives. Arguments based upon hydrogen's environmental cleanliness and freedom from dependence upon carbon resources are not compelling. (auth)

6450 Hydrogen for the subsonic transport. Korycinski, P.F.; Snow, D.B. (Langley Research Center, Hampton, VA). pp 819-838 of In Hydrogen energy. Part B. Veziroglu, T.N. (ed.). New York; Plenum Publishing Corp. (1975).

From Hydrogen economy Miami energy conference; Miami Beach, Florida, USA (18 Mar 1974).

See CONF-740306—PB.

Subsonic air transports can be designed to use effectively the high energy content of hydrogen. The advantage of hydrogen over other fuels increases as the size and range increases. Although the change from conventional jet fuel to liquid hydrogen is a major departure in airplane design, a substantial base of hydrogen technology exists in both the space and aeronautics programs which can be applied to support the engineering design and development of subsonic hydrogen airplanes. (auth)

6451 Liquid hydrogen as a fuel for future commercial aircraft. Lessard, R.D. (United Aircraft Research Labs., East Hartford, CT). pp 839-857 of In Hydrogen energy. Part B. Veziroglu, T.N. (ed.). New York; Plenum Publishing Corp. (1975).

From Hydrogen economy Miami energy conference; Miami Beach, Florida, USA (18 Mar 1974).

See CONF-740306—PB.

This study had two main objectives: (1) the establishment of a realistic cost for liquid hydrogen delivered to the aircraft, and (2) the estimation of whether liquid hydrogen at this cost level would be competitive with conventional aircraft fuels. It was found that the least expensive commercial method for producing hydrogen is coal gasification. However, barring any major unforeseeable increases in the price of crude oil obtained from petroleum or projected from coal or oil shale, it does not appear that liquid hydrogen produced by any of the present or proposed processes could supplant conventional aircraft fuel in commercial aircraft before the year 2000. (auth)

6452 Utilization of hydrogen as an appliance fuel. Sharer, J.C.; Pangborn, J.B. (Inst. of Gas Tech., Chicago). pp 875-887 of In Hydrogen energy. Part B. Veziroglu, T.N. (ed.). New York; Plenum Publishing Corp. (1975).

From Hydrogen economy Miami energy conference; Miami Beach, Florida, USA (18 Mar 1974).

See CONF-740306—PB.

Some aspects of utilizing hydrogen as an appliance fuel are considered. Catalytic combustion techniques, attainable efficiencies, burner exhaust emissions, and the advantages and disadvantages of using hydrogen to fuel appliances are discussed. These investigations are part of an ongoing experimental research project sponsored by Southern California Gas Company. (auth)

6453 Air Force experience in the use of liquid hydrogen as an aircraft fuel. Dunnam, B.C. (Aero Propulsion Lab., Wright-Patterson Air Force Base, OH). pp 991-1010 of In Hydrogen energy. Part B. Veziroglu, T.N. (ed.). New York; Plenum Publishing Corp. (1975).

From Hydrogen economy Miami energy conference; Miami Beach, Florida, USA (18 Mar 1974).

See CONF-740306—PB.

Liquid hydrogen has been of continual interest to the Air Force because of the advantages of some of its favorable physicochemical properties. These properties have the potential of increasing range to permit mission accomplishment unobtainable by other more conventional means. Over the past several decades, a great deal of experience has been gathered in not only the use of liquid hydrogen in aircraft design and turbine engine development but also in its production, handling and transport. This paper summarizes the Air Force story of hydrogen as an aircraft fuel as well as the development of hydrogen production facilities and transportation vehicles. (auth)

6454 Investigation of hydrogen fuel for naval vehicles. Quandt, E. (Naval Ship Research and Development Center, Annapolis). pp 1011-1020 of In Hydrogen energy. Part B. Veziroglu, T.N. (ed.). New York; Plenum Publishing Corp. (1975).

From Hydrogen economy Miami energy conference; Miami Beach, Florida, USA (18 Mar 1974).

See CONF-740306—PB.

Three separate NSRDC associated programs in hydrogen fuel are described from the standpoint of goals and progress to date. These are: (1) Hydrogen Fueled Small Boat Demonstration, (2) Feasibility study of Hydrogen Energy Systems for Naval Applications, (3) Installation of a Hydrogen/Oxygen Fuel Cell on the DSRV. By the completion of these programs, the Navy should have sufficient knowledge to determine those conditions under which full scale hydrogen fuel systems could benefit military missions. (auth)

6455 Application of hydrogen energy to ground vehicles. Quillian, R.D. Jr. (Fuels and Lubricants Research Lab., San Antonio); Weidhuner, D.D. pp 1021-1026 of In Hydrogen energy. Part B. Veziroglu, T.N. (ed.). New York; Plenum Publishing Corp. (1975).

From Hydrogen economy Miami energy conference; Miami Beach, Florida, USA (18 Mar 1974).

See CONF-740306—PB.

The possible major applications of hydrogen for Army material would be for ground vehicles, aircraft, and fuel cells. This paper is limited to an assessment of hydrogen and hydrogen-based fuels for ground vehicles, since hydrogen-based fuels for aircraft and fuel cells are adequately covered in other sessions. (auth)

PROPERTIES

6456 Investigation of the ignition characteristics of H_2—O_2—N_2 mixtures. Karim, G.A. (Univ. of Calgary, Canada); Rashidi, M.; D'Souza, M.V. pp 697-715 of In Hydrogen energy. Part B. Veziroglu, T.N. (ed.). New York; Plenum Publishing Corp. (1975).

From Hydrogen economy Miami energy conference; Miami Beach, Florida, USA (18 Mar 1974).

See CONF-740306—PB.

The paper describes an analytical approach incorporating detailed chemical kinetics of the combustion of H_2-O_2-N_2 mixtures in a reciprocating engine. The role of various operating parameters was determined primarily in relation to the length of the ignition delay and the attending peak values of cylinder pressure and temperature. Moreover, the extent of production of oxides of nitrogen in the exhaust was examined in terms of cycle parameters and the oxygen index of the charge. It is also shown that reliable predictions can be made of the ignition characteristics of H_2-O_2-N_2 mixtures in steady flow combustors. (auth)

6457 Surface electronic properties and the search for new hydrogen oxidation catalysts. Laramore, G.E.; Houston, J.E.; Park, R.L. (Sandia Labs., Albuquerque, NM). pp 889-899 of In Hydrogen energy. Part B. Veziroglu, T.N. (ed.). New York; Plenum Publishing Corp. (1975).

From Hydrogen economy Miami energy conference; Miami Beach, Florida, USA (18 Mar 1974).

See CONF-740306—PB.

The development of cheap substitutes for the "noble" metals as oxidation catalysts provides alternatives to direct combustion in the utilization of hydrogen as an energy source. Current likely candidates are the transition metal carbides which have many of the desirable properties of the "noble" metals with respect to hydrogen oxidation and hydrogenolysis. In an attempt to understand this phenomenon and to perhaps systematize the search for new catalytic materials, we have measured and compared the surface electronic properties of tungsten, tungsten carbide, and platinum. (auth)

6458 Hydrogen in metals: a new theoretical model. Switendick, A.C. (Sandia Labs., Albuquerque, NM). pp 1029-1042 of In Hydrogen energy. Part B. Veziroglu, T.N. (ed.). New York; Plenum Publishing Corp. (1975).

From Hydrogen economy Miami energy conference; Miami Beach, Florida, USA (18 Mar 1974).

See CONF-740306—PB.

Calculations for cubic metal hydride structures have shown the factors contributing to stable hydride formation. Hydrogen perturbs a certain class of electronic states strongly, namely those associated with s-like character at the hydrogen site. The calculations enable us to determine these states and their energy position and relate the stabiity of various hydride structures to the hydrogen locations and spacing, thus indicating a maximum hydrogen density. The implication of these results to the solubility of hydrogen in metals is discussed. (auth)

6459 Hydrogen and the integrity of structural alloys. Johnson, H.H.; Kumnick, A.J. (Cornell Univ., Ithaca, NY). pp 1043-1055 of In Hydrogen energy. Part B. Veziroglu, T.N. (ed.). New York; Plenum Publishing Corp. (1975).

From Hydrogen economy Miami energy conference; Miami Beach, Florida, USA (18 Mar 1974).

See CONF-740306—PB.

Steady-state permeation behavior of hydrogen in iron and steel is well characterized experimentally at temperatures above 5°C and hydrogen pressures above 0.01 atm. Transient measurements show strong effects of microstructure-dependent hydrogen trapping at temperatures in the vicinity of 300°K. Hydrogen attack at elevated temperatures and pressures results from an interaction between diffusing hydrogen and carbides, the generation of methane, and the appearance of voids and eventually fissures in the material. Hydrogen brittleness near 300°K is more severe at slow strain rates and is a maximum at about 300°K and diminishes at both lower and higher temperatures. The susceptibility to hydrogen brittleness increases with strength level of the steel. Hydrogen brittleness in fatigue is observed at lower strength levels than in static loading. Limited experiments suggest that oxygen additions may eliminate hydrogen-induced crack growth under some circumstances. (auth)

6460 Hydrogen-environment embrittlement of metals and its control. Chandler, W.T.; Walter, R.J. (Rockwell International, Canoga Park, CA). pp 1057-1078 of In Hydrogen energy. Part B. Veziroglu, T.N. (ed.). New York; Plenum Publishing Corp. (1975).

From Hydrogen economy Miami energy conference; Miami Beach, Florida, USA (18 Mar 1974).

See CONF-740306—PB.

Types of hydrogen embrittlement, characteristics of hydrogen-environment embrittlement, the degree of hydrogen-environment embrittlement of a wide variety of alloys, the effect of hydrogen environments on various properties, for example, tension, fatigue, creep and fracture mechanics properties, and the influence of hydrogen exposure parameters on the degree of embrittlement are discussed. Methods of designing for high-pressure hydrogen service and for prevention of hydrogen-environment embrittlement are also covered. (auth)

6461 Crystallographic distribution of hydrogen on catalytic surfaces. Panitz, J.A. (Sandia Labs., Albuquerque, NM). pp 1079-1087 of In Hydrogen energy. Part B. Veziroglu, T.N. (ed.). New York; Plenum Publishing Corp. (1975).

From Hydrogen economy Miami energy conference; Miami Beach, Florida, USA (18 Mar 1974).

See CONF-740306—PB.

The first direct crystallographic distribution data for hydrogen on iridium are presented. The use of a new surface analytic technique, field desorption spectrometry is described. Selective adsorption was observed in the vicinity of the (321) plane of iridium. It is suggested that such selectivity may be due to hydrogen permeation of interstitial lattice spaces. Highly localized adsorption sites randomly distributed on the surface appear to be associated with impurity atoms. (auth)

6462 Hydrogen distribution profiling. Langley, R.A.; Picraux, S.T.; Vook, F.L. (Sandia Labs., Albuquerque, NM). pp 1089-1103 of In Hydrogen energy. Part B. Veziroglu, T.N. (ed.). New York; Plenum Publishing Corp. (1975).

From Hydrogen economy Miami energy conference; Miami Beach, Florida, USA (18 Mar 1974).

See CONF-740306—PB.

A technique using nuclear microanalysis has been developed to determine deuterium concentration versus depth profiles in the near surface regions (approximately 2μm) of solids. The technique uses an incident ^{3}He beam and detects the nuclear reaction products from the reaction ^{3}He(d,p) ^{4}He, as well as the Rutherford scattered ^{3}He from atoms of the solid. By energy analysis of the ^{4}He recoils the deuterium concentration-depth profile can be determined. Details and results of the technique are presented for ErD_2. Using the same reaction the lattice location of ^{2}D in single crystals can be determined. The technique utilizes deuterium implantation followed by analysis with a channeled ^{3}He beam. Results are presented for ^{2}D in tungsten. (auth)

OTHER SYNTHETIC AND NATURAL FUELS

HYDROCARBON FUELS

6463 (AD/A—000100) New class of high-density fuels: 7-(N,N-dialkylamino)-1,3,5-triazaadamantanes (diadam fuels). Nielsen, A.T. (Naval Weapons Center, China Lake, Calif. (USA)). Oct 1974. 27p. (NWC-TP—5676). NTIS $3.75.

A new class of high-density fuels has been synthesized—the 7—(N,N-dialkylamino)-1,3,5-triazaadamantanes (diadam fuels). They are readily prepared in high overall yield from inexpensive reactants including principally ammonia; formaldehyde, nitromethane, alkanals and hydrogen (55—60 percent by weight from ammonia and formaldehyde). Bipropellant systems using these fuels are hypergolic. The new fuels have several other desirable properties including high density, high hydrogen density, high specific impulse, and high volumetric heat of combustion. They are thermally stable and non-corrosive. Their high solubility in most solvents including benzene and water imparts added safety in the event of spillage. Compared to certain other high-density fuels they have relatively low viscosities and low pour points. A brief discussion of new ideas in the fuel design, and a correlation between structure of the diadam fuels with selected physical properties (density, melting point, heat of combustion) are presented. (auth)

6464 (CONF-740727—P1) **Methanol as an alternate fuel. Volume I. Conference report. 1974 Engineering Foundation conference, Henniker, New Hampshire, July 7—12, 1974.** (Engineering Foundation, New York (USA)). 1974. 71p. New England Coll., Henniker, NH.

From Engineering foundation conference) methanol fuel; Henniker, New Hampshire, USA (8 Jul 1974).

The recommendations of the committee workshops on methanol fuel supply, methanol fuel uses, and government action on methanol fuel are presented. The sources considered with domestic gas, foreign gas, coal, and municipal solid wastes. The uses considered were in the electrical utility industry, as automotive fuel, as specialty fuel in industry and agriculture, in fuel cells, non-fuel markets, and special situations. Government action should be to devise appropriate mechanisms to share the risk of developing a methanol fuels industry with the private sector and to remove existing constraints. (JSR)

6465 RECYCLING AND DISPOSAL OF SOLID WASTES: INDUSTRIAL, AGRICULTURAL, DOMESTIC. Yen, T.F. (ed.). Ann Arbor, MI; United States of America (USA); Ann Arbor Science Publishers Inc. (1975). 380p. $20.00.

In the 12 papers written by experts in various areas of waste recycling and disposal, both practical and theoretical aspects of the problem are considered. Topics discussed include biodeterioration, liquid and gaseous fuels from organic solid wastes, animal waste management, farm and field wastes, chemical aspects of plastic waste management, polymer—gas reactions, recycling and disposal of waste plastics, use of polymers for stabilizing mineral wastes, flocculation of wastes by ionene polymers, recycling of glass and metals, single cell protein from cellulosic waste, and leachate formation in sanitary landfills. Many of the papers have extensive bibliographies. Each chapter was indexed for input into ERDA's data bases. (JSR)

ALCOHOL FUELS

6466 (CONF-740727—P2) **Methanol as an alternate fuel. Volume II. Reprints of papers. 1974 Engineering Foundation conference, Henniker, New Hampshire, July 7—12, 1974.** (Engineering Foundation, New York (USA)). 1974. vp. New England Coll., Henniker, NH.

From Engineering foundation conference) methanol fuel; Henniker, New Hampshire, USA (8 Jul 1974).

The papers presented are compiled. The topics discussed were the background and manufacture of methanol fuel, its uses in electrical utilities, uses in motor vehicles, ERDA task force study, other uses of methanol fuel, and research and development proposals for the synthesis and use of methanol fuel. Individual abstracts were prepared for six papers. The other papers were indexed for ERDA's energy data base. (JSR)

6467 (CONF-740727—P2, pp Paper D.1, 53p.) **Production of methanol from coal for the automotive market.** Jaffee, H. (Atomic Energy Commission, Washington, DC); Endleman, F.; Hightower, J.R.; Berger, B.; Crothers, W.; Pasternak, A.; Carter, R. 1974.

From Engineering foundation conference) methanol fuel; Henniker, New Hampshire, USA (8 Jul 1974).

In Methanol as an alternate fuel. Vol. II.

The results of a recent AEC study on the production of methanol from coal for the automotive market are presented. It is concluded that the technology does exist for commercial conversion of coal to methanol by several alternate processes. The estimated cost of the product is presented based upon utility and industrial financing. It is also concluded that methanol can be used in the automotive market, either in pure form or as a blend with gasoline. Here, however, there is a need for supporting R and D to verify the suitability of the product to the market. A plan is presented for design and construction of a demonstration plant, along with parallel vehicle application R and D. Additional market application studies are recommended. (auth)

6468 (CONF-740727—P2, pp Paper F.2, 32p.) **Methanol from forestry, municipal and agricultural organic residues.** Rohrmann, C.A.; Mudge, L.K.; Hammond, V.L. (Battelle Pacific Northwest Labs., Richland, WA). 1974.

From Engineering foundation conference) methanol fuel; Henniker, New Hampshire, USA (8 Jul 1974).

In Methanol as an alternate fuel. Vol. II.

Potentials for the use of renewable resources, specifically forestry, municipal, and agricultural residues, as primary raw materials for the production of methanol are reviewed. The basis for such processing would involve the conversion of the residues to a gaseous mixture of suitable composition such that methanol could be obtained by more-or-less conventional synthesis methods. (auth)

6469 (CONF-740727—P2, pp Paper F.4, 20p.) **Methanol as a fuel in the urban energy economy and possible source of supply.** Steinberg, M.; Salzano, F.J.; Beller, M.; Manowitz, B. (Brookhaven National Lab., Upton, NY). 1974.

From Engineering foundation conference) methanol fuel; Henniker, New Hampshire, USA (8 Jul 1974).

In Methanol as an alternate fuel. Vol. II.

The potential uses of methanol as an automtive fuel, in fuel cells, and as fuel for electrical utilities are briefly reviewed. The production of methanol as a by-product in the steel industry from the CO produced in blast furnaces, from the CO_2 recovered from the exhaust gases of a fossil-fueled power plant, and by operation of a fossil-fuel furnace as a synthesis gas producer maximizing CO production are discussed as possible sources of methanol in addition to the well-known processes of coal gasification, natural gas reforming, petroleum reforming, and distillation of wood and agricultural products. The process potential of a fossil-fuel furnace optimized for methanol production is examined and a flowsheet is given. (JSR)

6470 (CONF-740727—P2, pp Paper G.4, 12p.) **Environmental aspects of methanol as vehicular fuel.** Berger, B.J. (Univ. of California, Livermore). 1974.

From Engineering foundation conference) methanol fuel; Henniker, New Hampshire, USA (8 Jul 1974).

In Methanol as an alternate fuel. Vol. II.

The environmental and health consequences that can be predicted as a result of the use of methanol as a transportation fuel are summarized. Those areas that require further research before evaluation of environmental consequences can be completed are indicated. These include particularly the effects on terrestrial and aquatic ecosystems. (JSR)

6471 (CONF-740727—P2, pp Paper G.5, 6p.) **Environmental aspects of methanol as vehicular fuel: air quality effects.** Pollack, R.I. (Univ. of California, Livermore). 1974.

From Engineering foundation conference) methanol fuel; Henniker, New Hampshire, USA (8 Jul 1974).

In Methanol as an alternate fuel. Vol. II.

The Livermore Regional Air Quality model (LIRAQ) was developed to consider the effects of both transport and photochemistry in relating emissions to ambient air concentrations. The application of this model for the case of methanol-fueled vehicles to determine the impact on the overall O_3, NO/sub x/, peroxyacetyl (PAN), CH_2O, and other exhaust emissions is briefly discussed and the required changes in the model are indicated. (JSR)

6472 (UCRL-Trans—10697) **Methanol as a fuel.** Yamamoto, T. Translated from *Sekiyu Gakkaishi;* **16**: No. 10, 825-828(1973). 16p. Dep. NTIS $3.50.

The significant difference between methanol fuel and hydrocarbon fuel is that the latter has a heating value of 10,000 cal and the former has 5,000 cal, one half of the latter, and the latter has 50-100 cal of latent heat of vaporization and the former has a great latent heat of vaporization of 263 cal. Moreover, methanol is soluble in water and sensitive to various kinds of chemical reaction. These properties are drawbacks as a fuel. However, they are changed into advantages by suitable application and treatment. The following uses for methanol are discussed: 1) source material for hydrogen; 2) fuel for small scale electricity generation by fuel cells; 3) fuel for a boiler which does not produce NO/sub x/; 4) fuel for a non-polluting car; 5) resources for city gas; 6) use for the production of deoxidizing gas in metallurgy; and 7) use for the synthesis of protein from methanol feeding microbes. These usages make use of the special properties of methanol and can display the true value of methanol as a fuel. It is not fair to compare methanol with petroleum fuel or LNG only

from the standpoint of the heating value. Recently the discussion on the economical comparison of LNG with imported methanol which is produced in great amounts in the place of production of natural gas is prevailing. It is clear that methanol has an advantage when it is used for the previously stated purposes. (auth)

6473 Sources and methods for methanol production. Reed, T.B. (Massachusetts Inst. of Tech., Cambridge); Lerner, R.M. pp 1265-1278 of In Hydrogen energy. Part B. Veziroglu, T.N. (ed.). New York; Plenum Publishing Corp. (1975).

From Hydrogen economy Miami energy conference; Miami Beach, Florida, USA (18 Mar 1974).

See CONF-740306—PB.

Methanol and methyl fuel promise to be useful clean fuels for internal combustion engines and other liquid fuel applications. The various sources for synthesis of methanol are surveyed, and methods of synthesis are discussed. Various factors affecting production and use economics are listed and production cost from coal, lignin, waste and wood are estimated. (auth)

INORGANIC HYDROGEN COMPOUND FUELS

6474 Ammonia as a hydrogen carrier and its application in a vehicle. Graves, R.L.; Hodgson, J.W.; Tennant, J.S. (Univ. of Tennessee, Knoxville). pp 755-764 of In Hydrogen energy. Part B. Veziroglu, T.N. (ed.). New York; Plenum Publishing Corp. (1975).

From Hydrogen economy Miami energy conference; Miami Beach, Florida, USA (18 Mar 1974).

See CONF-740306—PB.

One possible solution to alleviate the transportation and storage problems of liquid hydrogen involves the use of hydrogen carriers. This paper examines one possible carrier--anhydrous ammonia--and introduces new data regarding its emissions and utilization in a small vehicle. (auth)

SOLAR ENERGY

RESOURCES AND AVAILABILITY

6475 (AD/A—004007) **Computations of daily solar radiation on inclined surfaces.** Portig, W.H. (Army Tropic Test Center, New York 09827 (USA)). Nov 1974. 60p. NTIS $4.25.

The quantity of solar radiation impinging on the surface of materials is of extreme importance to scientists concerned with outdoor weathering of materials. Forecasting this solar radiation load and its effects is difficult because of the many factors (astronomical, atmospheric, and material surface conditions) that may alter the quality and quantity, and hence the effects of the incoming radiation. This report deals with the theoretical computation of the angle at which samples of materials should be exposed if they are to receive maximum solar radiation, taking into consideration only the uniqueness of the astronomical and surface position factors. Data summaries are presented that show the amount of radiation impinging on the surface of materials inclined at different angles for worldwide locations. (NTIS)

6476 (ANCR—1269) **Solar radiation flux and insolation data for southern Idaho.** Buchenauer, C.J. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). Nov 1975. Contract E(10-1)-1375. 9p. Dep. NTIS $4.00.

Weather data pertinent to the development of solar energy heating in the Northern Intermountain region were desired for the purpose of assessing the usefulness and potential economics of utilizing solar energy in the region. The data reported herein are for several southern Idaho stations and for Salt Lake City, and are considered to be representative of the area from the eastern slopes of the Cascades to the western slopes of the northern Rockies. While existing data are not highly accurate and are derived from widely separated stations, approximate estimates may be made for the solar flux in the area. Methods for acquiring more detailed data in specific locations are described in this report. (auth)

6477 (COM—75-50181) **Report of the workshop on accurate radiometry for solar conversion. Final report.** Geist, J.; Steiner, B. (National Bureau of Standards, Washington, D.C. (USA)). Sep 1974. 5p.

Published in pp 204-208 of Report and Recommendations of the Solar Energy Data Workshop, Sep 1974.

Recommendations of a workshop on the accuracy of radiometry for solar conversion that was jointly sponsored by NOAA and NSF are presented. (auth)

6478 (UCRL—76603) **Using a zonal atmospheric model to test biogeophysical feedback-caused drought in the subtropical desert.** Potter, G.L.; MacCracken, M.C.; Ellsaesser, H.W.; Lovill, J.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Aug 1975. 28p. (CONF-750619—3). Dep. NTIS $5.00.

From 56. annual meeting of the American Geophysical Union; Washington, District of Columbia, USA (16 Jun 1975).

Recent interest in the cause of the sub-Sahara drought has initiated several investigations implying possible anthropogenic origin through increased surface albedo due to reduced plant cover from overgrazing. Results of two integrations of the Zonal Atmospheric Model (ZAM2) are presented, differing only in the prescribed surface albedo for the subtropical land masses of the northern hemisphere. These studies were initiated to determine whether an albedo change alone can bring about such dramatic impacts on local precipitation rates as have been implied. Preliminary results indicate that an albedo change can affect the climate, not just at the latitude of change but also at other latitudes due to various atmospheric feedback mechanisms. (auth)

6479 Energy from the Sun. Phillips, M.G.R. pp 126-48 of In Physics and the energy industry. Summer school in physics. Bedford Park, South Australia; Flinders University (1974).

From Summer school on physics and the energy industry; Bedford Park, Australia (Jan 1974).

See CONF-740137—.

Solar energy holds the potential to supply all of a nation's energy needs and so relieve demands on fossil fuels and reduce environmental pollution. Considerable research and development will be required particularly in the following areas: economics of systems; production and marketing; crop management; materials and process development; building design. The substantial advantages of solar energy over other forms means that development programmes certainly deserve high priority in the coming decade. It has been suggested that by 2000 AD in Australia solar energy could provide 10^{18} J/yr as low/medium grade heat and another 10^{18} J/yr in the form of synthetic fuels. This would represent 25% of projected needs--a substantial contribution. To achieve this goal would cost ~$25 x 10^9 and would return ~$3 x 10^9 per year in cost of fuel saved. The reward seems worth pursuing. (Summary modifed)

HEAT STORAGE AND REJECTION

6480 (ERDA—117) **Solar energy subsystems employing isothermal heat storage materials. Project technical report for phase I, September 18, 1974—April 30, 1975.** Lane, G.A.; Glew, D.N.; Clarke, E.C.; Quigley, S.W.; Rossow, H.E. (Dow Chemical Co., Midland, Mich. (USA)). May 1975. 43p. Dep. NTIS $4.00.

The literature was searched for phase-change solar heat storage candidate materials melting in the range 10 to 90°C. About 200 salts, organic compounds, and eutectic substances were selected initially. These are tabulated in this report. Through the use of DTA and freezing curve data, this group was reduced to approximately 50 candidates, about 20 of which exhibit little or no supercooling. The latter are prime candidates for encapsulation studies. Heat of fusion measurements have been made on most of these 20 materials. Thermal cycling studies have begun, and other tests are under way. (auth)

SOLAR ENERGY CONVERSION

6481 Sandia Laboratories' energy system simulation computer program. Edenburn, M.W. (Sandia Labs., Albuquerque, NM). pp 280-281 of In 1975 International Solar Energy Congress and Exposition. Rockville, MD; International Solar Energy Society (1975).

From Annual meeting of the International Solar Energy Society; Los Angeles, California, USA (28 Jul 1975).

See CONF-750712—.

6482 Nitinol heat engines. Banks, R. (Lawrence Berkeley Lab., CA). pp 525-526 of In 1975 International Solar Energy Congress and Exposition. Rockville, MD; International Solar Energy Society (1975).

From Annual meeting of the International Solar Energy Society; Los Angeles, California, USA (28 Jul 1975).

See CONF-750712—.

PHOTOVOLTAIC CONVERSION

6483 (AD/A—013921) **Hardened violet response silicon solar cell for satellite application. Final report, June 1973—April 1975.**

Iles, P.A. (Globe-Union, Inc., El Monte, Calif. (USA). Centralab Semiconductor Div.). May 1975. 50p. NTIS $3.25.

This contract involved development of further hardened versions of violet response solar cells, by adding aluminum contacts, and by testing the effects of higher resistivity silicon. The conventional violet cells improved steadily in output during the contract (70-79 mW 2 x 2 cm). There were difficulties in applying suitable fine line aluminum contacts to the shallow diffused front surface of the cell. The best violet cells with aluminum contacts were about 10% lower in output than the usual violet cells. Radiation tests showed that low resistivity (1-3 ohm-cm) silicon still gave best overall cell performance. Limited environmental tests showed that the performance of violet cells was satisfactory. More intensive study of the overall contact properties is suggested. Violet cells with both conventional and aluminum contacts, and covering a decade of bulk resistivity values, were delivered for evaluation, and for associated tests. (NTIS)

6484 (AD/A—015840) **Stress free application of glass covers for radiation hardened solar cells and arrays. Interim report, January 1974—June 1975.** Kirkpatrick, A.R.; Minnucci, J.A. (Simulation Physics, Inc., Burlington, Mass. (USA)). Jun 1975. Contract F33615-74-C-2001. 42p. (AFAPL-TR—75-54). NTIS $3.75.

This report describes the first sixteen months of a two and one half year program to develop a practical integral protective cover for silicon solar cells. The report discusses selection of Corning 7070 borosilicate glass as an optimum cover material and explains the mechanics of the electrostatic field-assisted bonding process used for cover application. Excellent results have been achieved for most solar cell types. Under environmental evaluations and electron and proton irradiation tests integrally covered cells exhibit performance statistically at least equal to that of cells with conventional glued covers. (NTIS)

6485 (ANL-K—75-3171-1) **Photovoltaic engineering services pertinent to solar energy conversion.** Bell, R.O.; Ho, J.C.T.; Kurth, W.; Surek, T. (Mobil Tyco Solar Energy Corp., Waltham, Mass. (USA)). Jun 1975. Contract W-31-109-Eng-38. 127p. Dep. NTIS $7.00.

For Argonne National Lab., IL.

The application of the compound parabolic concentrator (CPC) for use with solar cells has been investigated. Experiments with state-of-the-art Si cells in a CPC and under solar concentration were performed. A theoretical model for calculating the behavior of Si solar cells with concentration was developed. Detailed calculations of the energy distribution in the CPC were made. Finally a cost effectiveness analysis shows that the CPC system will produce power at very much lower cost than will flat panel solar cell arrays. (auth)

6486 (ANL-K—75-3191-1) **Preliminary evaluation of two-element optical concentrators for use in solar photovoltaic systems.** (Spectrolab, Inc., Sylmar, Calif. (USA)). 30 Jun 1975. Contract W-31-109-Eng-38. 64p. Dep. NTIS $5.50.

For Argonne National Lab., IL.

The objective of this program was: to evaluate for photovoltaic applications the use of the compound parabolic concentrator design as a field collector—in conjunction with a primary focusing concentrator. The primary focusing concentrator may be a parabolic reflector, an array of Fresnel mirrors, a Fresnel lens, or some other type; Select several candidate configurations of such compound systems (focusing concentrators/CPC field collectors); Perform an analytic evaluation of the technical performance of these systems; and identify the most promising configurations and perform a cost effectiveness study pertinent to coupling CPC concentrators to solar cells. (WDM)

6487 (ERDA/JPL—954289-75/1) **Development of methods and procedures for high rate low energy expenditure fabrication of solar cells. Quarterly progress report No. 1, September 27—December 31, 1975.** Kirkpatrick, A.R.; Minnucci, J.A. (Simulation Physics, Inc., Burlington, Mass. (USA)). Jan 1976. Contract 954289. 14p. Dep. NTIS $3.50.

For Jet Propulsion Lab., Pasadena, CA.

The objective of this program is to develop high rate, energy efficient solar cell processing techniques based around ion implantation and elimination of all conventional thermal operations. Cells have been fabricated using an abbreviated series of vacuum process operations performed at room temperature. (auth)

6488 (ERDA/JPL—954328-75/1) **Studies of encapsulant materials for terrestrial solar-cell arrays. First quarterly progress report, October 9—December 9, 1975.** Carmichael, D.C. (comp.). (Battelle Columbus Labs., Ohio (USA)). 22 Dec 1975. Contract NAS7-100. 24p. Dep. NTIS $3.50.

Study 1 of this contract is entitled "Evaluation of World Experience and Properties of Materials for Encapsulation of Terrestrial Solar-Cell Arrays." The approach of this study is to review and analyze world experience and to compile data on properties of encapsulants for photovoltaic cells and for related applications. The objective of the effort is to recommend candidate materials and processes for encapsulating terrestrial photovoltaic arrays at low cost for a service life greater than 20 years. The objectives of Study 2, "Definition of Encapsulant Service Environments and Test Conditions," are to develop the climatic/environmental data required to define the frequency and duration of detrimental environmental conditions in a 20-year array lifetime and to develop a corresponding test schedule for encapsulant systems. (WDM)

6489 (NSF-RA-N—75-019, pp 99-108) **Solar collectors of solar one.** Kuzay, T.M.; Malik, M.A.S.; Boeer, K.W. (Univ. of Delaware, Newark). May 1975.

From Workshop on solar collectors for heating and cooling of buildings; New York, New York, USA (21 Nov 1974).

In Proceedings on solar collectors for heating and cooling of buildings.

The "Solar One", University of Delaware's solar house-laboratory,is located in Newark, Delaware (39° 42' North latitude). Particulars of the house as a solar system have been given elsewhere. The system operates with air, converts solar energy into electricity and thermal energy simultaneously, and uses a salt hydrate type phase change heat storage. The solar collector development program of the house is geared to satisfy the requirements for an efficient CdS/Cu_2S solar cell operation and the melting of the salt hydrates in its main storage bin. The solar cells have higher efficiency and longer life expectancy at lower temperatures. A panel temperature of 65°C is acceptable. On the other hand, to melt the phase change storage materials, the discharge air temperature from the collectors should be about 8 to 11°C above the melting temperature of 49°C. Coupled to these requirements is the additional condition that the pressure drop across the solar collectors should remain low for economic fan operation in the air circuit. Within these guidelines, certain collector plate designs are adopted. This presentation gives some detail of the initial research findings on two particular solar collector duct designs. These involve finned ducts and the results of pressure drop and heat transfer measurements in these ducts are reported and compared with results from non-finned smooth ducts of similar dimensions. The measurements cover the transition flow regime and the lower region of the turbulent flow regime. (auth)

6490 (PB—239512) **Investigation of thin film solar cells based on Cu_2S and $CuInS_2$ and ternary compounds.** Mittleman, S.D. (Brown Univ., Providence, R.I. (USA)). Apr 1974. 113p. (NSF/RA/N—74-047). NTIS $5.25.

The two semiconductor systems based on Cu2S (a constituent of the Cu-Cd-S solar cell) and CuInS2 (a I-III-VI2 ternary semiconductor compound) are studied. The use of cathodoluminescence as a non-destructive, easily used method of characterizing these materials is demonstrated. In the case of the Cu-S system it was found that of all the compounds tested only Cu2S emits a cathodoluminescence spectrum. The spectrum consists of a band whose maximum lies at a photon energy corresponding to an energy gap of about 1.26 eV. It is shown that such a spectrum is emitted by the thin Cu-S layer formed on P-Cu(X)S/N-CdS heterojunction solar cells as well as other Cu2S layers formed by sulfurization of Cu films. In the case of polycrystalline CuInS2 "stoichiometric" powders exhibited bands at 0.87 micrometers, 1.05 micrometers, and 1.55 micrometers. Conductivity and Hall co-efficient measurements were made on some single crystals, and the results were partially correlated with observed changes in luminescence spectra. These results indicate that cathodoluminescence could be used to distinguish between N- and P-type thin films of CuInS2 like those which would be used on solar cells. (auth)

6491 (PB—239760) **Research and development of low-cost processes for integrated solar arrays. Semiannual progress report No. 1, 15 April—30 June 1974.** Kapur, V.; Macdiarmid, A.G.; Noel, G.T.; Pope, D.P.; Wolf, M. (National Center for Energy Management and Power, Philadelphia, Pa. (USA)). Jul 1974. 106p. (NSF/RA/N—74-152(5)). NTIS $5.25.

A program to study process routes leading to low cost silicon solar array manufacture for terrestrial applications was initiated. Potential processes for the production of low cost solar-grade silicon are reviewed and evaluated from a thermodynamic point of view, resulting in a classification of processes as either feasible or unfeasible. Preliminary experimental studies of a silicon purification process using the SiF4/SiF2 silicon transport reaction yielded a transport rate of 10 milligrams of silicon per liter of SiF4 at a flow rate of 20 liters per hour. Processes for the formation of thin large area crystalline silicon sheets are reviewed and assessed;

hot rolling, growth from a binary melt, thermal cycle annealing, and zone melting are identified as processes requiring further study. An effort to develop a methodology for the comparative rating of candidate processes is discussed. (NTIS)

6492 (PB—241054) **Investigation of thin film solar cells based on Cu_2S and certain ternary compounds. Semiannual progress report, 1 June—31 December 1974.** Loferski, J.J. (Brown Univ., Providence, R.I. (USA)). Jan 1974. 66p. (NSF/RA/N—75-016). NTIS $4.25.

Thin films of the Cu-S system have been prepared by sulfurizing thin films of copper on CdS single crystals, silica substrates and Si single crystals previously covered by a thin silicon oxide layer. In all these cases it was possible to produce films which were mainly Cu2S but an unidentified phase close in composition to Cu2S was always present in the films. Whereas the chemical dipping process produces CuXS films consisting of single crystal regions having areas in excess of micrometers, the films produced by sulfurization had a much smaller grain size. The photovoltaic output of cells made by the chemical dipping process on single crystal CdS and CdS(1-X)Te(X) where = or less than 0.01 were compared; no significant difference was observed. Cathodoluminescence spectra were recorded for Cu2S samples of various types on an improved OPTO-electronic system; it was found that the Cu2S line is narrower than had been previously reported. Copper indium sulfide films were produced by sulfurizing sputtered coin films in H2S/H2 at 400C. (NTIS)

6493 (SAND—75-0551) **Program Plan: Systems Definition Project of the Energy Research and Development Administration's National Photovoltaic Conversion Program.** (Sandia Labs., Albuquerque, N.Mex. (USA)). 15 Oct 1975. Contract AT(29-1)-789. vp. Dep. NTIS $5.00.

This Program Plan describes the Systems Definition Project to be accomplished by Sandia Laboratories for the Energy Research and Development Administration's (ERDA) National Photovoltaic Conversion Program. The Program Plan includes the scope and objectives of the Project, the overall plan for achieving them, the project management approach, and the interrelationship of this Project with the National Program and its various Projects. This Project is to be initiated by a Program Authorization Letter approving the overall Program Plan and authorizing the FY 76 portion of the plan as described in the FY 76 Annual Operating Plan. Each fiscal year an Annual Operating Plan reflecting the yearly plans and required resources will be submitted by Sandia for ERDA's approval. (auth)

6494 (TT—74-58063) **Physics and technology of semiconducting materials and converters.** 1975. Translation of Seksiya C-1 of Doklady Vessoyuznoi Konferentsii po Ispolvzovaniyu Solnetsnoi Energii, Erevan, 17—21 June 1969, Moscow, 1969. 139p. NTIS $5.75.

From All-Union conference on the utilization of solar energy; Erevan, USSR (17 Jun 1969).

Topics discussed at the meeting included: CdS, CdSe, CdTe, solar photoelectric cells; silicon and germanium recombination processes; photoelements; P-N transitions of InP, GaP, and CdTe; gallium arsenides; thermoelectric materials. (auth)

PHOTOSYNTHETIC CONVERSION

6495 (LBL—4239) **Photosynthesis as a resource for energy and materials.** Calvin, M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Aug 1975. Contract W-7405-ENG-48. 64p. (CONF-750862—1; CONF-751045—1; CONF-751046—1). Dep. NTIS $6.25.

From 8. international photochemical congress; Edmonton, Alta, Canada (9 Aug 1975).

Photosynthesis, both natural and as a model process, is examined as a possible annually renewable resource for both material and energy. The conversion of carbohydrate from cane, beets, and other sources through fermentation alcohol to hydrocarbon may again become economic in the light of improved fermentation technology. It may also be possible to produce material by direct fermentation of relatively labile carbohydrates in seaweed. Even the direct photosynthetic production of hydrocarbon from known sources (Hevea, etc.), or newly bred ones, seems possible in view of the large number of species and the new techniques of plant cell cloning which have already been successful on sugar cane. Finally, more distantly, synthetic systems constructed on the basis of our growing knowledge of the photosynthetic processes may produce fuel fertilizer and power. Some steps in the sequence of transfers in green plants have already been demonstrated in synthetic systems. However, the actual physical construction of such a complete system is a much more complex task. (auth)

SOLAR THERMAL POWER PLANTS

6496 (PB—239185) **Solar power system and component research program. Final report, January 15—November 15, 1974.** Blake, F.A.; Walton, J.D. (Martin Marietta Aerospace, Denver, Colo. (USA)). 31 Jan 1975. 463p. (NSF/RA/N—75-002; MCR—75-9). NTIS $11.50.

System analysis and component designs are presented for a 100-MWe solar energy conversion power system. The component design phase is concentrated on the boiler/superheater steam generation equipment. Additionally, results from the user application analysis, meteorological analysis, economic analysis, and boiler superheater component design are included. (auth)

6497 **Solar thermal electric power generation in Egypt.** Cobble, M.H.; Smith, P.R. (New Mexico State Univ., Las Cruces). pp 531-532 of In 1975 International Solar Energy Congress and Exposition. Rockville, MD; International Solar Energy Society (1975).

From Annual meeting of the International Solar Energy Society; Los Angeles, California, USA (28 Jul 1975).

See CONF-750712—.

6498 **Simulation model for the dynamic performance analysis of solar thermal electric power systems.** Johnson, G.R.; Elgabalawi, N. (Colorado State Univ., Fort Collins). pp 539-540 of In 1975 International Solar Energy Congress and Exposition. Rockville, MD; International Solar Energy Society (1975).

From Annual meeting of the International Solar Energy Society; Los Angeles, California, USA (28 Jul 1975).

See CONF-750712—.

TOWER FOCUS POWER PLANTS

6499 (NSF-RA-N—75-019, pp 158-162) **Solar powered steam supplement for heating and cooling of buildings.** Cottingham, J.G.; Green, G.K. (Brookhaven National Lab., Upton, NY). May 1975.

From Workshop on solar collectors for heating and cooling of buildings; New York, New York, USA (21 Nov 1974).

In Proceedings on solar collectors for heating and cooling of buildings.

In the northeastern U. S., there is a great opportunity for a new energy source because the cost of energy from other sources has risen so sharply (if it is available at all). The feasibility of a small tower focus power plant is considered as a source of 350°F steam for heating, air conditioning, etc. In a small plant the mining accuracy can be relaxed and this could result in a considerable cost reduction in the mirrors and in the tracking mechanism. A cost analysis of such a system is presented. (LTN)

6500 **Solar tower concentrator.** Hildebrandt, A.F.; Vant-Hull, L.L.; Easton, C.R. (Univ. of Houston, TX). pp 450-451 of In 1975 International Solar Energy Congress and Exposition. Rockville, MD; International Solar Energy Society (1975).

From Annual meeting of the International Solar Energy Society; Los Angeles, California, USA (28 Jul 1975).

See CONF-750712—.

OCEAN THERMAL GRADIENT POWER PLANTS

6501 (COO—2692-1) **Prevention of biofouling on heat transfer surfaces of ocean thermal energy converters. Progress report, May 1, 1975—November 30, 1975.** Ostrozynski, R.L.; Jones, P.E. (Allied Chemical Corp., Buffalo, N.Y. (USA). Specialty Chemical Div.). Dec 1975. Contract E(11-1)-2692. 110p. Dep. NTIS $5.50.

The objectives of the program were to develop chemical processes utilizing a combination of certain fluorochemicals and tribulyltin based toxicants for treating the surfaces of metals which may be used to fabricate OTEC heat exchangers, and to demonstrate the effectiveness of these surface treatments as antibiofoulants. Aluminium alloy No. 3003-H14 and titanium were testd, neither of which proved satisfactory. (WDM)

6502 (ORO—4918-4) **Use of mixtures as working fluids in ocean thermal energy conversion cycles, phase I. Quarterly progress report, May 1, 1975—July 31, 1975.** Starling, K.E.; Fish, L.W.; Christensen, J.H.; Iqbal, K.Z.; Lawson, C.; Yieh, D. (Oklahoma Univ., Norman (USA). School of Chemical Engineering and Materials Science). 1975. Contract E(40-1)-4918. 19p. Dep. NTIS $3.50.

During the first quarter of this project, two OTEC (Ocean Thermal Energy Conversion) mixture cycle simulators have been developed, (1) OTEC 1, a simulation of the working fluid mixture thermodynamic cycle and (2)OTEC 2—1, a simulator obtained by upgrading OTEC 1 to include preliminary sizing routines for major equipment units (but ignoring mass transfer effects). Calculations using the OTEC 2—1 simulator indicated that for plants having equal heat transfer surface area (and therefore approximately equal capital cost), mixture OTEC cycles yield greater power output than pure fluid (propane) OTEC cycles. Subroutines from a previously developed thermodynamic properties program were incorporated in the OTEC 1 and OTEC 2—1 simulators for calculating densities, enthalpies, entropies, heat capacities, and K-values of vapor and liquid mixtures (limited presently to hydrocarbons) and for performing flash, dew point, bubble point, isentropic and isenthalpic calculations. A very preliminary study of use of ammonia-water mixtures in OTEC cycles has indicated that only small concentrations of water in ammonia can be tolerated in OTEC cycles because dew and bubble point temperature differences exceed 10°F for water mole percentages greater than 0.05%. More accurate data will be required to verify these preliminary conclusions. (auth)

6503 (ORO—4918-6) **Use of mixtures as working fluids in ocean thermal energy conversion cycles, phase I. Quarterly progress report, August 1, 1975—October 31, 1975.** Starling, K.E.; Fish, L.W.; Lawson, C.; Yieh, D. (Oklahoma Univ., Norman (USA). School of Chemical Engineering and Materials Science). 1975. Contract E(40-1)-4918. 13p. Dep. NTIS $3.50.

The third in the following sequence of OTEC (Ocean Thermal Energy Conversion) mixture cycle simulators has been developed: (1) OTEC 1, a simulation of the working fluid mixture thermodynamic cycle and (2) OTEC 2—1, a simulator obtained by upgrading OTEC 1 to include preliminary sizing routines for major equipment units (but ignoring mass transfer effects) and (3) OTEC 3—1, a simulator obtained by upgrading OTEC 2—1 to include preliminary equipment capital cost routines for major equipment units. Preliminary calculations using the OTEC 3—1 simulator have indicated that for plants having equal power output, mixture OTEC cycles have lower capital cost than pure fluid (propane) OTEC cycles. (WDM)

6504 (PB—242155) **Development of plastic heat exchangers for sea solar power plants. Final report, 10 June 1974—28 February 1975.** Suratt, W.B.; Hart, G.K.; Sieder, E.N. (DSS Engineers, Inc., Fort Lauderdale, Fla. (USA)). 10 Mar 1975. 150p. (NSF/RA/N—75-026). NTIS $5.75.

Conceptual designs of heat exchangers for the sea solar power plant using lost cost plastic surfaces are evaluated. Composite walls of conductive, filled high density polyethylene and multilayered thin films of impermeable plastics are used as the reference material. Plate surfaces using thin falling films for evaporation and condensation of ammonia are identified as the least expensive concept. Horizontal tubular units are considered but cost and complexity are greater. Cost of heat exchangers for a 240 mW (gross) ammonia plant is estimated at $47/kw which includes replacement of plastic surface twice during a 30 year plant life. Largest cost component is steel work at 56% for the plate unit and 66% for the tubular unit. Average overall heat transfer coefficients of 300 BTU/hr. (ft squared) f (clean) are feasible for ammonia heat exchangers. Prospects for successful development appear to be good. Technical aspects needing further refinement include: thermal conductivities of filled plastics; working fluid film coefficients and pressure drops; long term creep and environmental stress cracking resistance of filled plastic composites. (auth)

SOLAR RADIATION UTILIZATION

SPACE HEATING AND AIR CONDITIONING

6505 (AD/A—008789) **Spacecraft optical and thermal model. Final report, 4 February 1974—28 February 1975.** Hallstein, R.S.H. (Rockwell International Corp., Downey, Calif. (USA). Space Div.). Mar 1975. Contract F30602-74-C-0113. 92p. (RADC-TR—75-90). NTIS $4.75.

A $^1/_{10}$ scale model of spacecraft P72-2 was fabricated primarily from wood with adhesive application of surface covering materials identical to those applied to the full spacecraft. Actual solar cells and reflecting mirrors were also installed on the model in order to accurately reproduce their unique spectral reflectance characteristics. A thermal model for the P72-2 spacecraft with payloads was developed from the thermal model for the P72-2 alone. Indications are that in sun lit orbit, steady state temperatures will be similar to transient temperature. However, during eclipse periods, temperature excursions are large and transient data is significant. (auth)

6506 (BNL—20479) **Nighttime use of flat plate type solar energy collectors as a heat sink in "solar assisted heat pump" systems, a preliminary analysis.** Cottingham, J.G.; Wilhelm, W.G. (Brookhaven National Lab., Upton, N.Y. (USA)). 9 Sep 1975. 12p. Dep. NTIS $4.50.

In the cooling mode "solar assisted heat pump" systems pump heat from the building to a heat sink, usually an evaporative cooler. This component can be eliminated, if the flat plate solar energy collector, not otherwise used in this mode, could be used as a nighttime heat sink. This possibility is analyzed and found feasible for the climatic conditions found on Long Island, New York. (auth)

6507 (CONF-750712—8) **Sandia Laboratories energy system simulation computer program.** Edenburn, M.W. (Sandia Labs., Albuquerque, N.Mex.(USA)). 1975. 23p. Dep. NTIS $4.50.

From Annual meeting of the International Solar Energy Society; Los Angeles, California, USA (28 Jul 1975).

The Solar Energy Systems Division of Sandia Laboratories has developed a computer program (SOLSYS) which is primarily used to simulate the transient performance of solar energy systems. The program consists of a component subroutine library, an information subroutine library, a control component subroutine library and an executive program. Component subroutines model the performance of fluid handling components which can be connected to construct nearly any desired energy system. The component subroutine library presently contains 21 subroutines modeling collectors, storage units, power generation cycles, transmission and distribution hardware, heat exchangers, house equipment, and auxiliary energy components. Some components are modeled very accurately and others use simple energy conservation models. Information subroutines supply time-dependent information such as insolation data, weather data, heating requirements, air-conditioning requirements, hot water requirements, and electrical requirements to the program. Control component subroutines model components which control temperatures in the system and components which switch a fluid flow between fluid channels when switching is necessary. The executive program handles input and output and calls on subroutines in the appropriate order. SOLSYS is very flexible; system configuration modifications can be easily made, and component characteristics can be easily varied for parametric studies. The program has been used to predict the performance of Sandia's solar energy test bed when applied to a Sandia Laboratories building and to a small neighborhood of single family homes. Collector, power generation, and storage requirements for the two types of consumer have been determined and the details of system performance have been predicted. (auth)

6508 (NSF/RA/N—74-096) **Solar heating proof-of-concept experiment for a public school building. Report for the period 15 January 1974—15 May 1974.** (AAI Corp., Baltimore, Md. (USA)). Jun 1974. 111p. (ER—7934). GPO $3.05.

On January 14, 1974, AAI Corporation received a contract from the National Science Foundation to conduct a Solar Heating Proof-of-Concept Experiment (POCE) for a public school building. On March 1, 1974, one and a half months later, the experiment began as Timonium Elementary School became the first school in the United States heated by solar energy. In this brief period of time, AAI designed, manufactured, and installed a 5000 square foot collector array complete with mounting trusses, a 15,000 gallon water storage tank, school hot water heating system, and instrumentation. From March 1 to May 15 the selected wing of the school received 90% of its heat from the solar heating system. During this period, experimental data were collected and are presented in this report. This experiment has been successful since it has proven that the solar heating of schools is possible, practical, and socially acceptable. In addition, over 1200 gallons of fuel oil have been saved in the brief period the system has been in operation. This report describes the system in detail, presents the analysis of operation, and discusses recommendations and conclusions based upon the results of the experiment so far. (auth)

6509 (NSF-RA-N—75-019, pp 7-16) **Performance of the Fauquier High School solar heating system.** Szego, G. (InterTechnology Corp., Warrenton, VA). May 1975.

From Workshop on solar collectors for heating and cooling of buildings; New York, New York, USA (21 Nov 1974).

In Proceedings of the workshop on solar collectors for heating and cooling of buildings.

Collector area requirements were based upon meeting 100% of the space heating load under average weather conditions for the month of January. The collector area actually installed is 2,415 square feet, tilted at 53° to the horizontal, and facing due south. Two transparent covers over the absorber plates are required in the northern United States for reasonable heat collection efficiencies. The glazings used are double strength window glass (DSB) for strength and durability. The absorber plate is of aluminum and is

coated with a selective coating with α/epsilon = 3 and $\alpha \cong 0.93$. The plate has one inlet and one outlet for the flow of fluid and has tubes of approximately 0.2 inches hydraulic diameter spaced 2.4 inches apart. This design leads to about a 96% plate efficiency factor. The flow rate of water varies from about 9 to 14 lb/sub m/hr-ft^2 of collector area depending upon the mode in which the system is operating. The circulation pump requires an input of 1.13 KW. Two independent hot water tanks, each with 5,000 gallons capacity, have been employed for better storage utilization of the solar energy available on any given day. When the tanks are fully charged, they can meet the heat requirements for 6 to 10 consecutive days without sunlight, depending upon the severity of weather. The tanks, of reinforced concrete, are buried underground and have thermal insulation on all sides. On an average day, the heat loss from the tanks is equivalent to about 1°F drop in water temperature, not including heat demands from the classrooms. The system has worked reliably for over a year and heated 5 buildings for the better part of 2 heating seasons. Virtually no use of the original heating system was needed. The average performance exceeded the design target of 50 percent. (auth)

6510 (NSF-RA-N—75-019, pp 17-25) **North View Junior High School flat-plate liquid heating collectors.** Merrill, G.L. (Honeywell Inc., Minneapolis). May 1975.

From Workshop on solar collectors for heating and cooling of buildings; New York, New York, USA (21 Nov 1974).

In Proceedings of the workshop on solar collectors for heating and cooling of buildings.

A solar heating system in a suburban school in Minneapolis, MN is described. Flat plate collectors of 5000 square feet with liquid heat transfer performed at 35 to 55 percent efficiency for pool air heating, pool water heating, domestic water heating and storage tank charging. Some leaks were encountered. (LTN)

6511 (NSF-RA-N—75-019, pp 26-32) **Solar collector design and performance experience: the Grover Cleveland School, Boston, Massachusetts.** Kirkpatrick, D.L. (General Electric Co., King of Prussia, PA). May 1975.

From Workshop on solar collectors for heating and cooling of buildings; New York, New York, USA (21 Nov 1974).

In Proceedings of the workshop on solar collectors for heating and cooling of buildings.

The major design features of the solar collectors installed by GE for the National Science Foundation on the Grover Cleveland Middle School, Boston, Massachusetts, in February 1974 are described. Preliminary performance data and some aspects of collector operating experience are also briefly presented. The solar collector array is comprised of 144 GE P3 4 x 8 ft. prototype collector modules. The basic P3 collector design concept is the result of a development program conducted by GE in 1973 in which particular emphasis was placed on the creation of a simple design from the standpoint of minimum parts, cost effective materials utilization and minimum fabrication labor which would serve as a prototype for low cost/high volume production. The resulting design is believed to combine inherent reliability, durability, and performance equalling or surpassing other known flat plate collectors having nonselective absorber surfaces. The absorber is Type 1100 aluminum alloy, which integral fluid passages formed using the OLIN RollBond process. The resulting panel has high thermal efficiency, is light in weight and low in both material and production cost. The absorber plate is coated with the 3M 301-C10 Black Velvet paint, baked at 350°F. Measured properties of this coating, as used in this application, are solar absorptivity, $\alpha = 0.975$, and infrared emissivity, $\epsilon = 0.907$. In the P3 collector the absorber and its molded polyurethane insulation are contained within a frame pan of weather-resistant 0.04 inch Type 5005 aluminum sheet. Combining the absorber plate, foam insulation and lightweight frame pan into a singlemolded assembly provides a number of unique performance enhancing and cost saving advantages. The inner and outer windows are of 0.08 in LEXAN UV-inhibited polycarbonate plastic sheet. This saves weight and the LEXAN is less susceptible to breakage than glass. Performance of these collectors has been better than was predicted. (auth)

6512 (NSF-RA-N—75-019, pp 33-40) **Flat-plate system operation and economics: Timonium Elementary School.** Barr, I.R. (AAI Corp., Baltimore). May 1975.

From Workshop on solar collectors for heating and cooling of buildings; New York, New York, USA (21 Nov 1974).

In Proceedings of the workshop on solar collectors for heating and cooling of buildings.

The solar collector system now successfully heating a portion of an elementary school in Timonium, Maryland is described. The completed system utilizes 5,000 square feet of collector mounted on the roof. A 15,000-gallon aluminum tank is used for storage. The solar collector banks are located on the central wing and heat that wing completely. The basic collector has a double glass layer separated by a large-cell aluminum honeycomb. A black honeycomb separates the inner glass layer from the aluminum sheet which is the absorber. The bottom layer of aluminum honeycomb and aluminum sheet have a high temperature epoxy black paint as the coating. Water passages along the bottom of the honeycomb allow gravity flow from top to bottom. The water flows through thin slots adjacent to the bottom plate in each honeycomb row and makes fine, slow-moving streams which pick up all the heat from the panel and the lower portion of the honeycomb. The performance of this system is described briefly. Plans for adding solar air conditioning with an absorption air conditioner are described. While the system works satisfactorily, such retrofitting is not economic at present fossil fuel costs. (auth)

6513 (NSF-RA-N—75-019, pp 48-54) **Colorado State University solar heated and cooled house.** Ward, D.S. (Colorado State Univ., Fort Collins). May 1975.

From Workshop on solar collectors for heating and cooling of buildings; New York, New York, USA (21 Nov 1974).

In Proceedings of the workshop on solar collectors for heating and cooling of buildings.

The design, fabrication and testing of flat plate solar collectors for a solar heated and cooled house at Colorado State University are described. The efficiency of the collectors was 40-55 percent, but varied with wind velocity, incident solar radiation, etc. to some extent. Costs are given. (LTN)

6514 (NSF-RA-N—75-019, pp 79-83) **Evaluation of the solar building, Albuquerque, N.M.** Gilman, S.F. (Pennsylvania State Univ., University Park). May 1975.

From Workshop on solar collectors for heating and cooling of buildings; New York, New York, USA (21 Nov 1974).

In Proceedings on solar collectors for heating and cooling of buildings.

An engineering company constructed in Albuquerque, N. M., the world's first solar-heated office building in 1956. It was concluded that, at that time, the economics of such systems were unfavorable. The solar heating system was operated until 1964 and then abandoned. Due to the energy crisis, it has been revived; corroded and leaking panels have been repaired, and an ethylene glycol-to-water heat exchanger added (to eliminate the freeze-up problem). New data are being taken with new instrumentation and are transmitted to the University of Pennsylvania for analysis. (LTN)

6515 (NSF-RA-N—75-019, pp 92-98) **Space heating with solar air collectors.** Loef, G.O.G. (Colorado State Univ., Ft. Collins). May 1975.

From Workshop on solar collectors for heating and cooling of buildings; New York, New York, USA (21 Nov 1974).

In Proceedings on solar collectors for heating and cooling of buildings.

The performance of a solar house in Colorado is given. This house has air heating solar collectors, rock bed heat storage, auxiliary heating and a control system. Moderate air cooling is obtained by drawing night air through an evaporative cooler and then through the rock bed; in the daytime cool air from the rock bed is circulated. The efficiency of the air heating collectors is about 50 percent; freezing, corrosion, fluid leaks, heat exchangers, etc. are avoided; there is minimum maintenance and a maximum service life. The beneficial effects of temperature stratification in the rock bed storage are outlined. (LTN)

6516 (NSF-RA-N—75-019, pp 131-140) **Project Sungazer: a vertical-vaned flat-plate collector with forced-air heat transfer.** Keyes, J.H. (International Solarthermics Corp., Nederland, CO). May 1975.

From Workshop on solar collectors for heating and cooling of buildings; New York, New York, USA (21 Nov 1974).

In Proceedings on solar collectors for heating and cooling of buildings.

A projected commercial solar heating system for houses (planned to cost less than $5000) is described. The system uses air instead of water for heat transfer, is mounted at ground level, has above ground rock bed storage (contiguous to but insulated from the collector), a collector engineered to be efficient and minimize losses, and a complex solid-state circuit control system. Various other details are given. Marketing plans involve obtaining patents and licensing manufacture of the system. (LTN)

6517 (NSF-RA-N—75-019, pp 262-266) **Solar energy cooling with zeolites.** Tchernev, D.I. (Massachusetts Inst. of Tech., Lexington). May 1975.

From Workshop on solar collectors for heating and cooling of buildings; New York, New York, USA (21 Nov 1974).

In Proceedings of the workshop on solar collectors for heating and cooling of buildings.

The objective of the program is to construct a demonstration module (3' x 3') consisting of 9 one-square-foot panels, which will contain a few hundred pounds of zeolite. The estimated cost of the panels is a few dollars per square foot, the cost of zeolite being less than $1/sq foot. Therefore, the cost per ton of air-conditioning for full size systems is expected to be on the order of a few thousand dollars, with no maintenance or energy cost thereafter. (WDM)

6518 (NSF-RA-N—75-019, pp 293-297) **Lockheed-Huntsville solar HVAC simulation model.** McCormick, P.O. (Lockheed Missiles and Space Co., Inc., Huntsville, AL). May 1975.

From Workshop on solar collectors for heating and cooling of buildings; New York, New York, USA (21 Nov 1974).

In Proceedings of the workshop on solar collectors for heating and cooling of buildings.

Results of the collector model have been compared with a large amount of data on widely differing flat plate collectors. In all cases the results have been very satisfactory. The steady state collector program has been documented informally and an input guide is available for anyone desiring to use the program. The total systems analysis program will be available in the summer of 1975. (WDM)

6519 (NSF-RA-N—75-019, pp 417-429) **An architect's view.** Grover, W.H. (Charles W. Moore, Associates, Essex, CT). May 1975.

From Workshop on solar collectors for heating and cooling of buildings; New York, New York, USA (21 Nov 1974).

In Proceedings of the workshop on solar collectors for heating and cooling of buildings.

A brief discussion of what an architect will expect in solar collectors is presented along with illustrations of the Barber house in Guilford, Connecticut. (WDM)

6520 (NSF-RA-N—75-019, pp 430-433) **Solar collectors and the mobile home.** Stringer, K.T. Jr. (Mobile Homes Manufacturers Association, Chantilly, VA). May 1975.

From Workshop on solar collectors for heating and cooling of buildings; New York, New York, USA (21 Nov 1974).

In Proceedings of the workshop on solar collectors for heating and cooling of buildings.

The mobile home industry represents one of the largest and most immediate potential users of solar energy systems. Some of the possibilities and problems of adapting solar heating and cooling systems to mobile homes are briefly discussed. (WDM)

6521 (NSF-RA-N—75-019, pp 210-212) **Summary of remarks.** Thomason, H.E. (Thomason Solar Homes, Inc., Washington, DC). May 1975.

From Workshop on solar collectors for heating and cooling of buildings; New York, New York, USA (21 Nov 1974).

In Proceedings on solar collectors for heating and cooling of buildings.

The patented SOLARIS solar collector operates efficiently (50 to 70 percent), at least partly due to operation at low temperatures (65 to 100°F). Operating at low temperature, one glass cover is sufficient which makes the collector lighter and reduces cost. Other materials are G.E. silicone, glass, vinyl, aluminum, fiberglass insulation, etc. The collectors are lightweight to minimize thermal capacity. Heat storage is in a water tank surrounded by stones and within the above temperature range which is sufficient to heat the house. For summer air conditioning, off-peak electric power is used at night to drive a small compressor and air conditioning coil to produce cool dry air which is circulated through the stones. During the day warm humid air from the house is circulated through the stones to cool and dry it. The automatic control system is simple and not expensive. (LTN)

6522 (NSF-RA-N—75078) **Assessment of a single family residence solar heating system in a suburban development setting. Annual report, 1 July 1974—31 July 1975.** Phillips, J.D. (City of Colorado Springs, Colo. (USA)). 10 Jul 1975. 229p. NTIS.

A gas moratorium in 1973 prompted the city of Colorado Springs to investigate alternate methods for space heating. This investigation led to the conclusion that solar heating could become a viable alternative. The city in conjunction with the American Institute of Architects, the Professional Engineers of Colorado, the Clearing House Association of Banks in the Colorado Springs area, the Homebuilders' Association, and interested individuals joined forces to form a community laboratory to construct and test a solar heated house. This house is better known as the Phoenix Project and is located in the northeast section of the city. This report is the result of one year's intensive investigation into four areas related to solar heating. Those areas are technical research on the system's components, economic research, legal research on zoning ordinances and building codes, and social acceptance research on the acceptability of solar heating. (WDM)

6523 (PB—238683) **Formulation of a data base for the analysis, evaluation, and selection of a low temperature solar powered air conditioning system. Final summary report.** Farber, E.A.; Morrison, C.A.; Ingley, H.A. (Florida Univ., Gainesville (USA)). 31 Jul 1974. 275p. (NSF/RA/N—74-067). NTIS $8.50.

Various methods by which solar energy can be used to accomplish comfort cooling are discussed. Data necessary in the analysis of such systems are given and a complete computer analysis of the best methods is presented. The ammonia water absorption system was selected after a thorough study as the best system at this time with the greatest promise of ultimate success and acceptability for solar air conditioning and refrigeration. A thorough literature review is presented. A study of the present state-of-the-art for both water and air cooled systems, a study of properties of refrigerants and absorber combinations, a complete computer performance analysis on two systems showing promise as solar air conditioning cycles, and recommendations are presented based upon an analysis of all these sources of information. (auth)

6524 (PB—239941) **Residential energy consumption and small-scale options of energy systems for space heating.** Chan, D.C. (Mitre Corp., Bedford, Mass. (USA)). Nov 1974. 64p. NTIS $4.25.

The recent oil crisis has drawn attention to New England's extreme dependence upon oil as a source of energy and, in particular, for space heating. In this study some alternatives to conventional fossil-fueled space heating systems are evaluated in terms of total annual costs to the consumer and fuel demand. It is concluded that a solar collector system back-up by conventionally fueled systems will be economically competitive if mass production is successful in reducing the manufacturing costs of solar panels. (NTIS)

6525 (PB—240553) **Assessment of a single family residence solar heating system in a suburban development setting. Monthly report.** Phillips, J.D. (Colorado Springs Dept. of Public Utilities, Colo. (USA)). 10 Nov 1974. 38p. (NSF/RA/G—74-018). NTIS $3.75.

Briefly discussed are problems and costs relating to a solar house heating system that is on automatic control. (GRA)

6526 (PB—240784) **Assessment of a single family residence solar heating system in a suburban development setting. Semiannual report, 1 July—31 December 1974.** Phillips, J.D. (Colorado Springs Dept. of Public Utilities, Colo. (USA)). 10 Jan 1975. 108p. (NSF/RA/G—74-028). NTIS $5.25.

This report discusses development of a solar-heated residence project in Colorado Springs, Colorado. It describes the house and the heating system and reports on the status of related information-gathering activities in areas affecting solar heating systems, such as legal, social acceptance and economic considerations. Outlines of the technical research being conducted, news clippings and an analysis of the questionnaires completed by persons visiting the house in July, 1974, are included. (auth)

6527 (PB—242727) **Assessment of a single family residence solar heating system in a suburban development setting. Monthly report, 10 May—10 June 1975.** Phillips, J.D. (Colorado Springs Dept. of Public Utilities, Colo. (USA)). 10 Jun 1975. 86p. NTIS $4.75.

An assessment of the solar heating system in the Phoenix house (Colorado Springs, CO) is given. An operational review of the mechanical system is attached. An outline of a workshop sponsored by the National Academy of Science (NAS) discusses the architectural and engineering considerations. The possibility of a solar institute for Colorado Springs is also discussed. (auth)

6528 (PB—242728) **Assessment of a single family residence solar heating system in a suburban development setting. Monthly report, 10 April—10 May 1975.** Phillips, J.D. (Colorado Springs Dept. of Public Utilities, Colo. (USA)). 10 May 1975. 72p. NTIS $4.25.

This report discusses technical operation and briefly notes the status of the preparation of legal research on a proposed zoning ordinance, an economic research study involving detailed analysis of two appraisals made on the solar home; insurance underwriting; load and demand on electric utilities, and the questionnaire which has been developed in the area of social research. (auth)

6529 (PB—242729) **Assessment of a single family residence solar heating system in a suburban development setting. Solar heated residence technical research experiment. Quarterly report, 1 October 1974—31 March 1975.** Phillips, J.D. (Colorado Springs Dept. of Public Utilities, Colo. (USA)). 10 Apr 1975. 66p. NTIS $4.25.

The system and its components have proven reliable and trouble-free. An air to air pump was used to simulate a fluid to air heat pump. The operation of the system to date indicates that the optimized heat pump is very reliable, and that the storage system on this project will sustain the optimized heat pump operation throughout the winter. The use of a heat transfer fluid such as Dowtherm J or Therminol 60 is an absolute necessity in the solar piping system and in the heat pump evaporator piping system. No fluid to air heat pumps suitable for this application have been found to be commercially available in the small packaged unit category. This report briefly describes building details, solar and mechanical systems operating modes, system component design and relationship to existing building codes, acquisition of system operation and performance data, technical operational and performance data, construction and operating costs, comparison of heat transfer fluids and problems encountered and their solutions. (auth)

6530 (PB—243117) **Energy conservation and window systems. A report of the summer study on technical aspects of efficient energy utilization, July 1974—April 1975.** Berman, S.M.; Silverstein, S.D. (American Physical Society, New York). Jan 1975. 107p. NTIS $5.25.

The architectural window is examined in detail to assess its role in reducing energy consumption for residential and commercial climate control. The cost-effectiveness of many existing and modified window systems is evaluated, and the positive role of solar heating through windows in winter is stressed. If properly designed, the winter solar heat gain (weather averaged) will exceed the thermal losses for east-, west-, and south-facing windows over most of the continental U.S. The report assesses the physics and technology of selective coating materials which act primarily as infrared reflectors to reduce thermal radiation transport, reviewing the properties of existing materials, exploring new methods for the deposition of selective surfaces on plastics, and identifying classes of new and promising semiconductor materials. (GRA)

6531 (PB—243548) **Assessment of a single family residence solar heating system in a suburban development setting. Quarterly report, July—September 1974.** Phillips, J.D. (Colorado Springs Dept. of Public Utilities, Colo. (USA)). 10 Oct 1974. 124p. (NSF/RA/G—74/029). NTIS $5.25.

A single family residence solar space heating system in a suburban development is evaluated. The project provides for (1) experimentation with solar space heating systems technology in a community setting, and (2) experiments with a solar space heating system that uses heat pump/storage combination. The Honeywell data access and analysis system will be used to study system operation, performance and cost compared to conventional cost. The report includes information on visitors to the house and relevant publicity and communications, as well as a technical progress report and related documentation. (NTIS)

6532 (PB—243549) **Assessment of a single family residence solar heating system in a suburban development setting. Monthly report.** Phillips, J.D. (Colorado Springs Dept. of Public Utilities, Colo. (USA)). 10 Feb 1975. 30p. (NSF/RA/G—75/005). NTIS $3.75.

This report describes the past month's research and related activities involving the engineering, economic, legal, and social aspects of the experimental solar house in Colorado Springs. Highlights included the installation of Honeywell measurement and analysis equipment; the press conference held in conjunction with the arrival of the family who will live in the home; and the purchase of the home by the City of Colorado Springs from the Phoenix Corporation. (NTIS)

6533 (PB—243550) **Assessment of a single family residence solar heating system in a suburban development setting. Monthly report.** Phillips, J.D. (Colorado Springs Dept. of Public Utilities, Colo. (USA)). 10 Mar 1975. 118p. (NSF/RA/G—75/006). NTIS $5.25.

This report describes research and related activities involving the engineering, economic, legal, and social aspects of the experimental solar house in Colorado Springs. (NTIS)

6534 (PB—244151) **Modeling of solar heating and air conditioning. Semiannual progress report, 1 July—31 December 1973.** Duffie, J.A.; Beckman, W.A. (Wisconsin Univ., Madison (USA). Engineering Experiment Station). 31 Jan 1974. 60p. (NSF/RA/N—74/186). NTIS $4.25.

A general program for simulation of operation of transient behavior of thermal systems is developed and applied to solar heating and cooling systems. It is based on a building block approach to solar process modeling in which individual components (collectors, storage systems, and controls) are modeled and the component models are assembled into a system model. (NTIS)

6535 (TID—26914) **Analysis of a solar total energy system.** Marshall, B.W. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1975. 28p. Dep. NTIS $5.00.

An analysis of a solar system to provide the electrical, thermal, and hot water requirements of a hypothetical 1000-home community in a total energy concept has been performed. The community is located in Albuquerque, New Mexico, and real 1962 solar and weather data for one week periods representing the spring, summer, fall, and winter seasons were used in the analysis. The system is composed basically of parabolic cylindrical collectors, high and low temperature storage systems, a turbogenerator, cooling towers, auxiliary fossil-fuel furnances, a thermal distribution system, and necessary pumps and controls. The system performance for four collector areas was evaluated and the fossil-fuel savings ranged from 36 to 79 percent. Using the criteria of overnight storage combined with minimum waste of solar energy, a system with a total collector area of 24390 sq. m. (262400 sq. ft.) was found to be near optimum. Economic analyses based on the levelized annual revenue concept were performed. These results, using selected economic parameters, suggest that over the next 30 years energy from the solar system would be less than 1.5 times more expensive than energy supplied to the home by conventional electric and natural gas means and this factor can be reduced by solar economic incentives and higher than predicted fossil fuel prices. (auth)

6536 **Assessment of solar heating and cooling for an electric utility company.** Braun, G.W. (Southern California Edison, Rosemead); Davis, E.S.; French, R.L.; Hirshberg, A.S. pp 37-38 of In 1975 International Solar Energy Congress and Exposition. Rockville, MD; International Solar Energy Society (1975).

From Annual meeting of the International Solar Energy Society; Los Angeles, California, USA (28 Jul 1975).

See CONF-750712—.

6537 **Models for solar heating and cooling systems and buildings.** Murray, H.S.; Shipley, J.P. (Los Alamos Scientific Lab., NM). pp 276-277 of In 1975 International Solar Energy Congress and Exposition. Rockville, MD; International Solar Energy Society (1975).

From Annual meeting of the International Solar Energy Society; Los Angeles, California, USA (28 Jul 1975).

See CONF-750712—.

6538 **Performance handbook for solar heating systems.** Dickinson, W.C. (Lawrence Livermore Lab., CA); Neifert, R.D.; Loef, G.O.G.; Winn, C.B. pp 289-290 of In 1975 International Solar Energy Congress and Exposition. Rockville, MD; International Solar Energy Society (1975).

From Annual meeting of the International Solar Energy Society; Los Angeles, California, USA (28 Jul 1975).

See CONF-750712—.

6539 **New cost-saving method for calculating the long-term performance of solar heating and cooling systems.** Davis, E.S.; Wen, L.C.; French, R.L. (Jet Propulsion Lab., Pasadena, CA). pp 291-292 of In 1975 International Solar Energy Congress and Exposition. Rockville, MD; International Solar Energy Society (1975).

From Annual meeting of the International Solar Energy Society; Los Angeles, California, USA (28 Jul 1975).

See CONF-750712—.

6540 **Performance comparison between a computer performance analysis model and the Solar Heated and Cooled Laboratory.** Johnson, G.R.; Winn, C.B. (Colorado State Univ., Fort Collins). pp 293-294 of In 1975 International Solar Energy Congress and Exposition. Rockville, MD; International Solar Energy Society (1975).

From Annual meeting of the International Solar Energy Society; Los Angeles, California, USA (28 Jul 1975).

See CONF-750712—.

6541 **Stochastic model for system sizing for space heating.** Lameiro, G.F.; Duff, W.S. (Colorado State Univ., Fort Collins). pp 299-300 of In 1975 International Solar Energy Congress and Exposition. Rockville, MD; International Solar Energy Society (1975).

From Annual meeting of the International Solar Energy Society; Los Angeles, California, USA (28 Jul 1975).

See CONF-750712—.

6542 Solar heating and cooling of the Santa Clara Community Center. Anderson, L.B. (Lockheed Palo Alto Research Lab., CA); Winn, C.B.; Johnson, G.R. pp 308-309 of In 1975 International Solar Energy Congress and Exposition. Rockville, MD; International Solar Energy Society (1975).

From Annual meeting of the International Solar Energy Society; Los Angeles, California, USA (28 Jul 1975).

See CONF-750712—.

6543 Design considerations of air cooled collector/rock-bin storage solar heating systems. Balcomb, J.D.; Hedstrom, J.C.; Rogers, B.T. (Los Alamos Scientific Lab., NM). pp 314-315 of In 1975 International Solar Energy Congress and Exposition. Rockville, MD; International Solar Energy Society (1975).

From Annual meeting of the International Solar Energy Society; Los Angeles, California, USA (28 Jul 1975).

See CONF-750712—.

6544 Analysis of a solar total energy system. Marshall, B.W. (Sandia Labs., Albuquerque, NM). pp 316-317 of In 1975 International Solar Energy Congress and Exposition. Rockville, MD; International Solar Energy Society (1975).

From Annual meeting of the International Solar Energy Society; Los Angeles, California, USA (28 Jul 1975).

See CONF-750712—.

6545 Design and operation of a retrofitted residential solar heating and cooling system. Hill, J.E.; Richtmyer, T.E. (National Bureau of Standards, Washington, DC). pp 324-325 of In 1975 International Solar Energy Congress and Exposition. Rockville, MD; International Solar Energy Society (1975).

From Annual meeting of the International Solar Energy Society; Los Angeles, California, USA (28 Jul 1975).

See CONF-750712—.

6546 Control system for solar heating and cooling. Wahlig, M.; Binnall, E.; Dols, C.; Graven, R.; Selph, F.; Shaw, R.; Simmons, M. (Univ. of California, Berkeley). pp 383-384 of In 1975 International Solar Energy Congress and Exposition. Rockville, MD; International Solar Energy Society (1975).

From Annual meeting of the International Solar Energy Society; Los Angeles, California, USA (28 Jul 1975).

See CONF-750712—.

6547 Control systems for solar heated and cooled buildings. Shipley, J.P. (Los Alamos Scientific Lab., NM). pp 387-388 of In 1975 International Solar Energy Congress and Exposition. Rockville, MD; International Solar Energy Society (1975).

From Annual meeting of the International Solar Energy Society; Los Angeles, California, USA (28 Jul 1975).

See CONF-750712—.

6548 Ammonia-water absorption air conditioner. Simmons, M.; Wolgast, R.; Wahlig, M. (Univ. of California, Berkeley). pp 400-401 of In 1975 International Solar Energy Congress and Exposition. Rockville, MD; International Solar Energy Society (1975).

From Annual meeting of the International Solar Energy Society; Los Angeles, California, USA (28 Jul 1975).

See CONF-750712—.

6549 Solar-powered heat pump with pivoting-tip vane expander and compressor. Fischer, R.D.; Frieling, D.H.; Talbert, S.G.; Eibling, J.A. (Battelle Columbus Labs., OH). pp 419-420 of In 1975 International Solar Energy Congress and Exposition. Rockville, MD; International Solar Energy Society (1975).

From Annual meeting of the International Solar Energy Society; Los Angeles, California, USA (28 Jul 1975).

See CONF-750712—.

6550 (TT—74-58066) **Methods of direct conversion of thermal energy into electrical energy.** 1975. Translation of Sektsiya C-6 of Doklady Vsesoyuznoi Konferensii po Ispolvzovaniyu Solnetsnoi Energii, Erevan, 17—21 June 1969, Moscow, 1969. 107p. NTIS $5.25.

From Erevan, USSR; 17 Jun 1969

All-Union conference on the utilization of solar energy.

Articles are presented that deal with conversion of solar energy into electrical energy, solar heating and cooling of buildings, solar water heating, and application of solar energy in greenhouses. (Portions of this document are not fully legible). (GRA)

6551 (ORNL-tr—4058) **Details of the Philips experimental house.** Bahr, H. Jun 1975. Translated by M. Gerrard from German press release No. 167/75. 14p. Dep. NTIS $4.50.

The Phillips Experimental House is described in terms of the solar collector, data recording and storage, living area, and power system (heat storage, heat pump, and air conditioning unit). (WDM)

DRYING AND CURING

6552 Grain drying with solar energy. Peart, R.M. (Purdue Univ., Lafayette, IN); Foster, G.H. pp 426-427 of In 1975 International Solar Energy Congress and Exposition. Rockville, MD; International Solar Energy Society (1975).

From Annual meeting of the International Solar Energy Society; Los Angeles, California, USA (28 Jul 1975).

See CONF-750712—.

WATER HEATING

6553 (NSF-RA-N—75-019, pp 68-72) **Compressed-film floating-deck solar water heater.** Davison, R.R. (Texas A and M Univ., College Station). May 1975.

From Workshop on solar collectors for heating and cooling of buildings; New York, New York, USA (21 Nov 1974).

In Proceedings of the workshop on solar collectors for heating and cooling of buildings.

The floating-deck heater consists of a deck of insulation—preferably foam glass—floating on the heated water. A compressing layer, that may be either transparent or the absorbing surface, rests directly on the insulation, and the glazing is situated above. Water flows in a thin film between the deck and the compressing layer. The advantages of this heater are that it provides internal short term storage, it is simple and relatively inexpensive to build, and it can be built in large modules. It is also capable of rapid response to solar conditions as it has minimal thermal lag. Several combinations of compressing layer and glazing have been tested. (auth)

6554 (NSF-RA-N—75-019, pp 413-416) **Users' experience with solar water heater collectors in South Florida.** Scott, J.E. (Univ. of Delaware, Newark). May 1975.

From Workshop on solar collectors for heating and cooling of buildings; New York, New York, USA (21 Nov 1974).

In Proceedings of the workshop on solar collectors for heating and cooling of buildings.

A brief account is given of a survey of users of solar hot water heaters in south Florida. The collector performance is briefly discussed. (WDM)

6555 (NSF-RA-N—75-019, pp 201-206) **Experience in the manufacture and service of solar water heater in Miami, Florida.** Robbins, W.R. Jr. (W.R. Robbins and Son Roofing Co., Miami, FL). May 1975.

From Workshop on solar collectors for heating and cooling of buildings; New York, New York, USA (21 Nov 1974).

In Proceedings on solar collectors for heating and cooling of buildings.

Experience with solar water heaters in Miami, Florida is reviewed. Copper tubing holds up satisfactorily. The use of galvanized iron resulted in deposits at joints and fittings which reduced circulation and caused leakage. The use of small sized brass fittings likewise resulted in calcification and plugging. An air space is necessary between the galvanized iron collector box and the roof to avoid corrosion of the box and premature aging of the roof. A long, maintenance-free life is necessary for amortization of the initial costs and can be attained with proper designs, choice of materials and proper installation. (LTN)

6556 Industrial process heat from solar energy: the ERDA—Sohio project. Iantuono, A.; Clark, A.F.; Day, J.A.; Dickinson, W.C. (Lawrence Livermore Lab., CA). pp 369-370 of In 1975 International Solar Energy Congress and Exposition. Rockville, MD; International Solar Energy Society (1975).

From Annual meeting of the International Solar Energy Society; Los Angeles, California, USA (28 Jul 1975).

See CONF-750712—.

6557 Design of solar-assisted gas-energy water heaters for U.S. apartments. Davis, E.S.; Bartera, R.E. (Jet Propulsion Lab., Pasadena, CA). pp 375-376 of In 1975 International Solar Energy Congress and Exposition. Rockville, MD; International Solar Energy Society (1975).

From Annual meeting of the International Solar Energy Society; Los Angeles, California, USA (28 Jul 1975).
See CONF-750712—.

6558 **Water from solar-heated ponds tested as a process-heat source.** Dickinson, W.C. (Lawrence Livermore Lab., CA). *Energy Res. Rep.*; 2: No. 1, 5-7(Jan 1976).

Solar ponds are being designed to preheat 400,000 gallons of water needed at 140°F for uranium ore backing as a hot, dilute acid. Oil burners will provide the final temperature needed. The design of such ponds, with thermal insulation on the bottom and plastic glazing on top, is discussed with respect to materials, their stability, thermal conductivity, etc. The economics is barely sufficient to justify the use of such ponds under present conditions (oil at $15/barrel) and with a 15 percent return on investment required. Effects of modest cost reductions, tax allowances or accelerated depreciation are discussed. (LTN)

HEAT ENGINES

6559 (UCID—3739) **Nitinol engine project test bed. Project final report, covering the period June 1, 1974—July 31, 1975.** Banks, R.; Hernandez, P.; Norgren, D. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 31 Jul 1975. 57p. (NSF/RANN/SE/AG—550/FR75/2). Dep. NTIS $4.50.

The Test Bed Engine was designed with the intent of reaching a 1-kilowatt size demonstration unit when operating as an engine. It can also be operated as a test bed driven by an electric motor for testing Nitinol elements. It was completed in December, 1974 and since has been operated in the test bed mode. Tests were run using 8-wire 0.5-mm-diameter 55-Nitinol elements cycled in tension; work per cycle was indicated on stress--strain oscillograms. Indicated power-per-kg measurements exceeded the long-range economic design objective. However, the very high power densities were accompanied by low endurance. The results of parametric studies and changes in Nitinol cyclic behavior are presented. (auth)

SOLAR COLLECTORS AND CONCENTRATORS

6560 (ANL-K—75-3190-1) **Goals study for technical development and economic evaluation of the compound parabolic concentrator concept for solar energy collector applications.** (Little (Arthur D.), Inc., Cambridge, Mass. (USA)). 18 Jul 1975. Contract W-31-109-Eng-38. 62p. Dep. NTIS $5.50.

For Argonne National Lab., IL.

The Argonne National Laboratories, contracted with Arthur D. Little, Inc. (ADL), to perform a 6 week goal study for the purpose of evaluating the technical applicability and the economic viability of the compound parabolic concentrator (CPC) concept for all solar energy applications except large central power plants. During this period, we studied the use of CPC units in a large number of residential, industrial, and commercial applications. The predicted performance of CPC augmented solar collectors was compared with other available solar collectors. Application of the CPC to on-site power generation using solar Rankine power generation techniques was studied in detail. Techniques and costs for fabricating CPC collectors were studied. Collectors with insulation and with full-surface reflectors were studied along with the use of CPC augmentation for evacuated receivers with selective surfaces. Manufacturing costs are compared with those reported by others. A qualitative comparison was made between the various classes of solar collectors that are either presently available or are expected to become available in the near future. Comparative energy costs for various collectors are discussed based upon the predicted performance and the estimated costs for manufacture. The problems of introducing the CPC, or other advanced technology type of solar collectors, into the U. S. construction and HVAC market are briefly discussed. (auth)

6561 (BNWL—1951) **Comparison of solar pond concepts for electrical power generation.** Drumheller, K.; Duffy, J.B.; Harling, O.K.; Knutsen, C.A.; McKinnon, M.A.; Peterson, P.L.; Shaffer, L.H.; Styris, D.L.; Zaworski, R. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Oct 1975. Contract E(45-1)-1830. vp. Dep. NTIS $5.45.

The objectives of this study were to: (1) Identify the various solar pond concepts for electric power generation, including but not limited to: (a) nonconvective salt gradient solar pond, (b) ponds with various plastic or other membranes at suitable locations to minimize or eliminate convection, (c) ponds which are totally or partially gelled to reduce or eliminate convection, and (d) shallow convecting ponds; (2) analyze and compare the performance of these various concepts; and (3) estimate the pond cost and overall power plant system cost for each concept assuming the nonconvective gradient salt pond as the base case. The approach includes a preliminary design of several power plant systems based on solar pond concepts, and performance and economic evaluation based on these preliminary designs. (WDM)

6562 (NSF-RA-N—75-019, pp 41-47) **Experimental evaluation of flat-plate collector configurations.** Ramsey, J.W. (Honeywell Inc., Minneapolis). May 1975.

From Workshop on solar collectors for heating and cooling of buildings; New York, New York, USA (21 Nov 1974).

In Proceedings of the workshop on solar collectors for heating and cooling of buildings.

Honeywell, under the sponsorship of NASA-Lewis Research Center, is conducting a study to analyze, design, fabricate and test flat plate solar collectors for the heating and cooling of buildings. The test phase of the contract is an integrated program consisting of both outdoor testing using natural sunlight and indoor testing using a solar simulator. A broad set of collector designs are being investigated. The collectors whose performance is described were all built identically with respect to their mechanical housing, their mounting brackets for the absorber plate, the edge and back insulation and the spacing and mounting of cover plates. Differences exist only in regard to the type of absorber plate surface coating and the number and type of cover plates. It was found that, when operating with the inlet fluid temperature of 120°F and only 50°F above ambient, differences in efficiency were relatively small for the collectors tested. However, for inlet temperatures of 200°F(130°F above ambient), large differences in efficiency existed. For this condition, which is typical of that required for use of a collector with an absorption air conditioner, the selectively coated collectors are distinctly better. (auth)

6563 (NSF-RA-N—75-019, pp 55-68) **Structurally integrated steel solar collector development.** Moore, S.W. (Los Alamos Scientific Lab., NM). May 1975.

From Workshop on solar collectors for heating and cooling of buildings; New York, New York, USA (21 Nov 1974).

In Proceedings of the workshop on solar collectors for heating and cooling of buildings.

The LASL flat plate collector design is based on combining the solar collector into a structural unit which doubles as that portion of the building roof. The installed unit is weather tight, insulated and readily maintainable. The concept is one which combines many of the most economic mass production manufacturing processes with inexpensive primary materials into a viable concept. Factory assembled cost predictions range from approximately $3.00 to $4.00 per square foot, based on large scale mass production and depending upon whether it is single or double glazed, or selective surface coated. (auth)

6564 (NSF-RA-N—75-019, pp 73-78) **Glass solar heat collector development.** Gillette, R.B.; Deminet, C.; Beverly, W.D. (Boeing Aerospace Co., Seattle). May 1975.

From Workshop on solar collectors for heating and cooling of buildings; New York, New York, USA (21 Nov 1974).

In Proceedings of the workshop on solar collectors for heating and cooling of buildings.

This research program is aimed at developing a solar collector which consists of a glass structure containing vacuum cells and liquid passageways. The vacuum cells are individually sealed in the manufacturing process at the glass fusing temperature (about 1000-1200°C). Hence, a partial vacuum of about $^1/_4$ atmosphere will exist at ambient temperature. The liquid passageways are interconnected in a labyrinth fashion as shown in the figure. Sunlight passes through the vacuum cells and is absorbed directly in a blackened liquid. Alternative approaches for absorbing sunlight include a blackened matrix suspended within the passageways, a blackened coating on passage walls, or absorbing glass walls. It is presently planned to insulate the back side and edges with urethane foam, although it would be possible to insulate the back with an additional layer of vacuum cells. The principal reasons for pursuing the development of a glass solar collector are low cost, and elimination of the need for large quantities of strategic materials such as aluminum and copper. Glass is inherently an abundant, low-cost raw material which lends itself to low production costs when highly automated. (auth)

6565 (NSF-RA-N—75-019, pp 87-91) **Long term (16 years) performance of an overlapped-glass plate solar-air heater.** Ward, J.C. (Colorado State Univ., Fort Collins). May 1975.

From Workshop on solar collectors for heating and cooling of buildings; New York, New York, USA (21 Nov 1974).

In Proceedings on solar collectors for heating and cooling of buildings.

The long-term performance of a residential solar heating system is being determined for a solar heated system which has

been operating continuously for sixteen years with no maintenance. This residential solar heating system is in the Colorado Solar House located in Denver, Colorado, and designed and operated by Dr. George O. G. Lof. The performance of this system was determined during the 1959-60 heating season, and the results were reported. The performance of this system is being redetermined during the present 1974-75 heating season so that changes in efficiency occurring during a period of 16 years can be observed. The system has operated continously since it was first installed in 1957 with no maintenance. Therefore, comparison of the data obtained during the two heating seasons will yield information regarding the rate of change of efficiency of solar collectors. Also, information is being obtained on the hot water heating system which is also solar heated. If the performance has deteriorated, it is planned to repair the system and determine the repaired performance. (auth)

6566 (NSF-RA-N—75-019, pp 109-118) **Heat pipes applied to flat-plate solar collectors.** Bienert, W.B. (Dynatherm Corp., Cockeysville, MD). May 1975.

From Workshop on solar collectors for heating and cooling of buildings; New York, New York, USA (21 Nov 1974).

In Proceedings on solar collectors for heating and cooling of buildings.

Heat pipes are passive heat transport devices of very high equivalent thermal conductance. Because of their high conductance, they appear to be well suited to transport the collected energy from the absorber to a liquid or air distribution system. The emphasis of this program is on the heat removal aspect of the collector. Other features of the collector such as surface coating, glazing, and insulation are assumed to be similar in technology to that employed in conventional collectors. The basic components of a heat pipe are shown. A small amount of liquid which is in equilibrium with its saturated vapor is sealed within a leak-tight envelope (usually a tube). Application of heat to one section of the envelope causes some evaporation of the liquid in this section. The excess vapor condenses at the unheated section (condenser) of the heat pipe. The condensate is pumped to the heated section (evaporator) by means of capillary forces in a wick, thus completing the cycle. Heat is transported by mass flow via the latent heat of evaporation. In some applications such as the present one, gravity can be utilized instead of capillary forces to return the condensate to the evaporator. Because the process of evaporation and condensation under constant pressure is basically isothermal, the heat pipe is capable of transporting thermal energy with very small temperature differences. The potential advantages (along with some disadvantages) of heat pipe solar collectors are listed. (auth)

6567 (NSF-RA-N—75-019, pp 119-130) **Flat-plate solar air collectors for agricultural use.** Cherne, J.M. (TRW Systems, Redondo Beach, CA). May 1975.

From Workshop on solar collectors for heating and cooling of buildings; New York, New York, USA (21 Nov 1974).

In Proceedings on solar collectors for heating and cooling of buildings.

Analyses and experimental tests used in the selection of the air collector configuration for the system test to be performed at California Polytechnic State University, San Luis Obispo, are described. Cal Poly's test of a solar-augmented, crop-drying system is being performed under NSF/RANN Grant GI 42944. The investigation of the solar system design included both a technical and economic point of view. Subscale components were designed and tested for performance. Economic analyses of the total cost of dried produce versus the parameters of temperature, fuel cost, equipment cost and life, and the alternates of system configuration were made. The results of these studies permitted the choice of the system described. This system has been detail designed and construction is under way. We expect to be drying crops in this facility early next year. (auth)

6568 (NSF-RA-N—75-019, pp 143-150) **Compound parabolic concentrators.** Sevcik, V.J.; Winston, R. (Argonne National Lab., IL). May 1975.

From Workshop on solar collectors for heating and cooling of buildings; New York, New York, USA (21 Nov 1974).

In Proceedings on solar collectors for heating and cooling of buildings.

The objective of this program is to explore the performance of several versions of the Compound Parabolic Concentrator (CPC) collector and to assess its applicability to economic utilization of solar energy for heating and cooling of buildings, central power, and photovoltaic power generation. With the CPC, it is possible to concentrate solar energy by a factor of 10 or so without diurnal tracking. The design basis is considered and various possible configurations are discussed. One of these designs has been constructed and the performance testing methods and test results are reported. (auth)

6569 (NSF-RA-N—75-019, pp 150-157) **Development of a solar heat supply system with fixed mirror concentrators.** Williams, J.R. (Georgia Inst. of Tech., Atlanta); Hutchins, S.F. May 1975.

From Workshop on solar collectors for heating and cooling of buildings; New York, New York, USA (21 Nov 1974).

In Proceedings on solar collectors for heating and cooling of buildings.

Many potential applications of solar energy require higher temperature collection than is possible with flat plate collectors, so focusing collectors must be used. Since large concentrating surfaces are subject to high wind loadings, it is often advantageous to fix the reflecting surface in a stationary supporting structure and steer a much smaller heat exchanger so that it remains in the focal region. Several fixed concentrator moving heat exchanger systems have been proposed using spherical and parabolic concentrators. Large reductions in the cost of mechanical structures and mechanisms can result only if the movable heat collector is much smaller than the reflecting surface, a requirement corresponding to good focus for all incident directions. Russell proposed a faceted fixed mirror concentrator (FFMC) that has no off-axis aberration and focuses sunlight sharply regardless of the incident light direction. The FFMC is composed of long, narrow flat reflecting elements arranged on a concave cylindrical surface. The angles of the reflecting facets are fixed so that the focal distance is twice the radius of curvature of the cylindrical surface (instead of half) for light normal to the concentrator aperture. The line of focus always lies on the reference cylindrical surface, parallel to the fixed mirrors, so the heat collector can be supported on armsthat pivot at the center of the reference cylinder. This greatly simplifies the positioning of the heat exchanger. A simple four-bar linkage can be used to keep the heat exchanger rotated toward the incoming heat flux, so that a terminal concentrator on the heat exchanger can be used to further improve collection efficiency. A concentrator of 61 ft^2 has been built and tested. A second system of 540 ft^2 has been designed and is being constructed. (auth)

6570 (NSF-RA-N—75-019, pp 163-173) **Cost effect focusing collector for solar heating and cooling.** Barr, I.R. (AAI Corp., Baltimore). May 1975.

From Workshop on solar collectors for heating and cooling of buildings; New York, New York, USA (21 Nov 1974).

In Proceedings on solar collectors for heating and cooling of buildings.

The basic design concept is for a roof-top solar concentrator composed of a fixed roof of somewhat cylindrical shape which is also the mirror of the concentrator. A collector of $^1/_3$ to $^1/_{10}$ the area of the mirror is moved at intervals daily to be in the approximate focus of the mirror concentrator. This system is optimized in angular setting for the heating and cooling requirements of a building and its latitude. Many combinations and concepts have been investigated. In areas of the South and Southwest it appears that the high temperature capability of this concentrator would allow the generation of electrical power required for some of the school's operation; then, by cascading the waste heat to run an absorption air-conditioner at 200°F, provide services hot water and heating, and with a chiller water storage tank, utilize the chiller water generated by the absorption unit for cooling. This would provide a total energy concept for areas where sunshine is plentiful. (auth)

6571 (NSF-RA-N—75-019, pp 174-178) **Modeling and construction of the stationary reflector/tracking absorber solar collector.** Kreider, J.F. May 1975.

From Workshop on solar collectors for heating and cooling of buildings; New York, New York, USA (21 Nov 1974).

In Proceedings on solar collectors for heating and cooling of buildings.

It is the purpose of the development effort described herein to bring to the functional level both a mathematical and physical prototype of the Stationary Reflector/Tracking Absorber (SRTA) solar collector. This collector concept is due to Dr. W. Gene Steward of ECS, Inc. and consists of a spatially fixed, internally reflectorized segment of a sphere and a sun-tracking cylindrical absorber. It differs fundamentally from earlier concentrators in that the reflector need not move to track the sun; only the small absorber pipe moves in a planar trajectory to track the virtual, diurnal motion of the sun. The development program whose results are described herein has been under way for about one year under private funding of Steward and the author. (auth)

6572 (NSF-RA-N—75-019, pp 179-190) **Economic considerations for focusing collectors.** Kreith, F. (Univ. of Colorado, Boulder). May 1975.

From Workshop on solar collectors for heating and cooling of buildings; New York, New York, USA (21 Nov 1974).

In Proceedings on solar collectors for heating and cooling of buildings.

The objective of this presentation is to outline criteria to be used in comparing the cost of useful energy delivered by different types of solar collectors, to summarize available cost projections for SRTA focusing collectors, and to present preliminary results on the performance of a Stationary Reflector/Tracking Absorber (SRTA) solar energy collector. Economic evaluations of the cost of solar energy should be based on the useful energy delivered per net dollar investment, not on the cost of the collector alone. The most significant features of current types of solar energy collectors, i.e., flat plate, intermediate concentration, high concentration with tracking reflector, high concentration with stationary reflector, are summarized (auth)

6573 (NSF-RA-N—75-019, pp 193-200) **Development and practical application of solar energy in Austrlia.** Bauer, F.D. (Beasey Industries Pty. Ltd., Devon Park, Australia). May 1975.

From Workshop on solar collectors for heating and cooling of buildings; New York, New York, USA (21 Nov 1974).

In Proceedings on solar collectors for heating and cooling of buildings.

In Australia, natural gas has been unavailable, and electricity has been unavailable or expensive (if available), while sunshine is abundant. As a result, and with the encouragement of the government and assistance by CSIRO, solar water heaters using flat plate solar collectors have become increasingly popular. Various types and designs are described, including some industrial applications. With the advent of increased fuel costs and cheaper solar absorbers, a growth rate of 35 percent per annum is forecast. (LTN)

6574 (NSF-RA-N—75-019, pp 207-209) **Summary of remarks.** Lewchuk, R.R. (PPG Industries, Inc., Pittsburgh). May 1975.

From Workshop on solar collectors for heating and cooling of buildings; New York, New York, USA (21 Nov 1974).

In Proceedings on solar collectors for heating and cooling of buildings.

In 1973 PPG Industries reviewed the energy situation, the market, and our ability to produce a product with existing facilities. As a result, PPG Industries decided to become not a total system supplier but a component supplier of certain parts and the total flat plate solar collector. We will supply tempered glass for those interested in producing their own solar collector or system. We will also provide double glazed units that can be fitted over other solar collector absorber plates or systems. And, of course, we will supply the total flat plate solar collector component. The PPG Baseline solar collector is a 34" x 76" self-contained unit comprised of the following: double glazed with 2 pieces of $^1/_8$" tempered glass; the outer ply needs to be tempered to withstand windload, hail and vandalism. The inner ply needs to be tempered to withstand the thermal stresses that can be induced in glass from temperature differentials. We offer an aluminum Rollbond panel as the absorber plate. The absorber coating is our PPG Duracron enamel which has been used in the spandrel areas of buildings for many years. It has an absorptance/emissivity ratio of 1.0 (95 percent absorptance). Although the above does not tax the limits of the technology, we have put together materials we believe are durable, will perform, and offered them at a published price. We have applied what we have learned over the past 40 years in the business of insulating glass to produce a highly cost-effective, trouble-free baseline collector. (LTN)

6575 (NSF-RA-N—75-019, pp 213-218) **Brief review of Fafco, Inc., experience in the development and marketing of a low-grade heat solar heating system.** Ford, F.A. (Fafco Inc., Menlo Park, CA). May 1975.

From Workshop on solar collectors for heating and cooling of buildings; New York, New York, USA (21 Nov 1974).

In Proceedings of the workshop on solar collectors for heating and cooling of buildings.

A brief summary of the experiences of FAFCO Inc. in the development of low cost plastic collector panels for swimming pool heating is presented. (WDM)

6576 (NSF-RA-N—75-019, pp 219-223) **Revere Solar Energy Collector.** Heidrich, W.J. (Revere Copper and Brass Inc., Rome, NY). May 1975.

From Workshop on solar collectors for heating and cooling of buildings; New York, New York, USA (21 Nov 1974).

In Proceedings of the workshop on solar collectors for heating and cooling of buildings.

The Revere Solar Energy Collector employs copper-laminated panels as collector plates. Rectangular copper tubes are secured to the panels by copper clips to assure good contact between the tubes and the copper surface. A conductive sealant is also used between the tubes and the collector plate to provide the highest degree of heat transfer. [WDM)

6577 (NSF-RA-N—75-019, pp 227-232) **Corrosion protection for aluminum solar energy collector plates.** Butt, S.H. (Olin Corp., East Alton, IL). May 1975.

From Workshop on solar collectors for heating and cooling of buildings; New York, New York, USA (21 Nov 1974).

In Proceedings of the workshop on solar collectors for heating and cooling of buildings.

Precautions should be taken to maximize the corrosion resistance of solar energy collector plates which operate with a water-base heat transfer fluid. Suggestions and discussion are offered for consideration by the user. "Typical" solar energy collector systems are "multi-metal" systems in which water-based heat transfer fluid circulates not only through aluminum but also through other metals. (WDM)

6578 (NSF-RA-N—75-019, pp 233-236) **Intermetallic absorption surface: material systems for collector plates.** Santala, T. (Texas Instruments Inc., Attleboro, MA). May 1975.

From Workshop on solar collectors for heating and cooling of buildings; New York, New York, USA (21 Nov 1974).

In Proceedings of the workshop on solar collectors for heating and cooling of buildings.

The objective of this project is to develop a composite metal solar collector plate in which an intermetallic absorption surface is integrally combined with a tube-in-sheet collector plate. The goal for the intermetallic absorption surface is solar absorptance $\alpha > 0.9$ and the infrared emittance $\epsilon < 0.3$. The goal for the tube-in-sheet collector plate development is to use the composite metals technology to combine materials and use them in quantities and locations which assure the best corrosion resistance and the most economic use of materials. (auth)

6579 (NSF-RA-N—75-019, pp 237-239) **Optical coatings for flat plate solar collectors.** Mar, H. (Honeywell, Inc., Minneapolis). May 1975.

From Workshop on solar collectors for heating and cooling of buildings; New York, New York, USA (21 Nov 1974).

In Proceeding. of the workshop on solar collectors for heating and cooling of buildings.

The purpose of the program is to investigate coatings which will enhance the performance and economic feasibility of flat plate collectors. The primary coatings of interest are electro-chemical and paint type solar absorber coatings and chemically etched antireflection coatings. (auth)

6580 (NSF-RA-N—75-019, pp 240-244) **Experimental radiative performance of moderately concentrating solar collectors.** Howell, J.R. (Univ. of Houston, TX). May 1975.

From Workshop on solar collectors for heating and cooling of buildings; New York, New York, USA (21 Nov 1974).

In Proceedings of the workshop on solar collectors for heating and cooling of buildings.

The paper by Bannerot (Session 6) describes fully the basic concept of the collectors being designed. The idea is to use reflecting surfaces of optimal geometry within the solar collector tray to allow increased collection temperatures at reasonable collector efficiencies. The particular geometry presently under study consists of trapezoidal grooves with mirrored sidewalls and an absorbing base. The grooves are aligned in an east-west orientation. Bannerot's paper describes the analytical prediction of the behavior of this type of collector. This paper is concerned with the experimental verification of the computer analysis. If the comparison is valid, then the much less expensive computer predictions can be used for further optimization of the geometry. (auth)

6581 (NSF-RA-N—75-019, pp 245-249) **Studies on methods for reducing heat losses from flat-plate solar collectors.** Hollands, K.G.T. (Univ. of Waterloo, Ont.). May 1975.

From Workshop on solar collectors for heating and cooling of buildings; New York, New York, USA (21 Nov 1974).

In Proceedings of the workshop on solar collectors for heating and cooling of buildings.

A number of studies are being conducted at the University of Waterloo, all related to methods for reducing heat losses from flat plate solar collectors. These include studies on (i) heat transfer by free convection across inclined air layers such as occur in flat plate collectors, (ii) suppression of free convection in these layers by honeycombs; and (iii) the transmittance of a new type of inner cover. (WDM)

6582 (NSF-RA-N—75-019, pp 250-253) **Transparent glass honeycomb.** Mackenzie, J.D. (Univ. of California, Los Angeles). May 1975.

From Workshop on solar collectors for heating and cooling of buildings; New York, New York, USA (21 Nov 1974).

In Proceedings of the workshop on solar collectors for heating and cooling of buildings.

The objectives of this one-year preliminary program are to design, build, and test a few thin-walled inorganic glass honeycombs of various geometries. From the performance and consideration of costs, one system will be selected. An industrial company (Hanibal Scientific, Brunswick, Georgia) will develop the continuous manufacturing process for the thin-walled glass. The final goal at the end of the one year period is to construct a 2' x 2' test module, evaluate its performance and offer recommendations for future applications. (WDM)

6583 (NSF-RA-N—75-019, pp 254-261) **Development of a flat-plate solar collector using transparent plastic honeycomb.** Marshall, K.N.; Wedel, R.K. (Lockheed Palo Alto Research Lab., Palo Alto, CA). May 1975.

From Workshop on solar collectors for heating and cooling of buildings; New York, New York, USA (21 Nov 1974).

In Proceedings of the workshop on solar collectors for heating and cooling of buildings.

A program to develop a honeycomb covered flat plate solar collector for use in the temperature range of 180 to 250°F (355 to 395°K) utilizing thin transparent plastic material for the honeycomb is described. The concept of using honeycomb to suppress the convection and radiation losses is reviewed, and the advantages of considering thin film plastic honeycombs are presented. The primary considerations in selection of materials and the final honeycomb configuration are discussed. Accomplishments during the first two months of the contract are presented. (auth)

6584 (NSF-RA-N—75-019, pp 267-274) **Thermic diode solar panels.** Buckley, S. (Massachusetts Inst. of Tech., Cambridge). May 1975.

From Workshop on solar collectors for heating and cooling of buildings; New York, New York, USA (21 Nov 1974).

In Proceedings of the workshop on solar collectors for heating and cooling of buildings.

Each panel is constructed from a wood or fiberglass frame with sheet metal inner and outer surfaces, forming a box approximately four feet by eight feet by six inches thick. A three inch thick slab of insulation divides the box into two layers: a quarter inch thick sensor layer on the outer surface and a three inch thick storage layer next to the inner surface. The sensor and storage layers are water filled vinyl bags. The bags have openings such that the only convective flow from one layer to the other is through a control box and a return duct. (WDM)

6585 (NSF-RA-N—75-019, pp 277-282) **Collector modeling.** Ramsey, J.W.; Schmidt, R.N. (Honeywell Inc., Minneapolis). May 1975.

From Workshop on solar collectors for heating and cooling of buildings; New York, New York, USA (21 Nov 1974).

In Proceedings of the workshop on solar collectors for heating and cooling of buildings.

This presentation briefly describes two computer models which Honeywell has used extensively in the conduct of its solar energy studies. One model uses a numberical ray trace technique to analyze concentrating collectors. The other uses a nodal analysis to predict flat plate collector performances. (auth)

6586 (NSF-RA-N—75-019, pp 283-292) **Thermal collector model in the U of P solar heating/cooling/electric power system computer simulation program.** Wolf, M. (Univ. of Pennsylvania, Philadelphia). May 1975.

From Workshop on solar collectors for heating and cooling of buildings; New York, New York, USA (21 Nov 1974).

In Proceedings of the workshop on solar collectors for heating and cooling of buildings.

The program has been successfully employed in its various operating modes, individually and as part of the total system program, for various collector research studies and for systems performance evaluations over various time periods, up to a year. A typical hourly run over a season for a heating-cooling system including storage control functions, using both Weather Bureau data and thermal load data on tape, and using weighted average optical data, has been found to cost $30 to $50 in computer charges. Making spectral runs, however, increases the costs substantially. (WDM)

6587 (NSF-RA-N—75-019, pp 298-305) **Hybrid simulation of solar HVAC system for house retro-fit design.** Schlesinger, R.J. (Rho Sigma Unlimited, Tarzana, CA). May 1975.

From Workshop on solar collectors for heating and cooling of buildings; New York, New York, USA (21 Nov 1974).

In Proceedings of the workshop on solar collectors for heating and cooling of buildings.

It is the objective of the initial phase of this work to develop a prototype hardware system capable of simulated solar heating ventilating and air conditioning performance when associated with a residential building. It is also an objective to provide a test bed for computer solar system design model verification. This simulated hardware approach can provide a very flexible and inexpensive method for determining the operation of a proposed solar heating system on a specific dwelling. Further, the system can be tailored to the specifications predicted by a particular computer model and the performance that would be realized if a full-scale solar system had been applied to the house may be observed. (auth)

6588 (NSF-RA-N—75-019, pp 306-314) **Moderately concentrating (not focusing) solar energy collectors.** Bannerot, R.B. (Univ. of Houston, TX). May 1975.

From Workshop on solar collectors for heating and cooling of buildings; New York, New York, USA (21 Nov 1974).

In Proceedings of the workshop on solar collectors for heating and cooling of buildings.

The accepted measure of the performance of a solar collector is collector efficiency at a given collection temperature. An ideal efficiency curve is plotted for a variety of solar collectors -- two are of the conventional flat-plate type, two are of the moderately concentrating (groove) type. The absorber plates are gray ($\alpha = \epsilon$) and spectually selective ($\alpha/subs/\epsilon// \cong 13$). Insolation is 350 Btu/ft²-hr. The purpose is to illustrate on the basis of relative ideal performance where the moderately concentrating collector fits into the overall collector picture. As can be seen, even with a gray (cheap and reliable) absorber plate the grooved collector performance approaches that of the flat-plate selective surface collector. Combining the moderately concentrating concept with a selective absorber plate significantly increases performance. (auth)

6589 (NSF-RA-N—75-019, pp 315-321) **Numerical modelling of thermal trap and water-trickle solar collectors.** Smith, P.R. (New Mexico State Univ., Las Cruces). May 1975.

From Workshop on solar collectors for heating and cooling of buildings; New York, New York, USA (21 Nov 1974).

In Proceedings of the workshop on solar collectors for heating and cooling of buildings.

Two types of flat plate solar collectors were analyzed numerically and the results compared to experiment. The solar collectors studied were a thermal trap collector and a water-trickle collector. The analysis of both collectors was on a time dependent basis and considered the thermal inertia of the water storage tank which the collectors supplied. The incident solar radiation and the ambient atmospheric temperature were taken to be known functions of time. (WDM)

6590 (NSF-RA-N—75-019, pp 322-327) **Hottel, Whillier, Bliss collector model.** Beckman, W.A. (Univ. of Wisconsin, Madison). May 1975.

From Workshop on solar collectors for heating and cooling of buildings; New York, New York, USA (21 Nov 1974).

In Proceedings of the workshop on solar collectors for heating and cooling of buildings.

A model for the useful energy gain of a flat plate collector is presented. (WDM)

6591 (NSF-RA-N—75-019, pp 341-348) **Proposed method of testing for rating solar collectors based on thermal performance.** Hill, J.E. (National Bureau of Standards, Washington, DC). May 1975.

From Workshop on solar collectors for heating and cooling of buildings; New York, New York, USA (21 Nov 1974).

In Proceedings of the workshop on solar collectors for heating and cooling of buildings.

The National Bureau of Standards has made a study of the different techniques that could be used for testing solar collectors and rating them on the basis of thermal performance. The result of the study was the development of a standard test procedure where the efficiency of the collector is obtained under "steady-state" conditions. The series of tests that comprise the testing procedure is conducted outside under real sun conditions and the results of the tests are displayed in graphical and tabular form. (WDM)

6592 (NSF-RA-N—75-019, pp 349-358) **Solar collector testing and standards.** Lior, N. (Univ. of Pennsylvania, Philadelphia). May 1975.

From Workshop on solar collectors for heating and cooling of buildings; New York, New York, USA (21 Nov 1974).

In Proceedings of the workshop on solar collectors for heating and cooling of buildings.

The need for setting quality and performance standards for solar collectors is briefly discussed. Criteria and test methods are considered. (WDM)

6593 (NSF-RA-N—75-019, pp 359-368) **Brief review of material property measurements for solar collector components.**

Streed, E.R. (National Bureau of Standards, Washington, DC). May 1975.

From Workshop on solar collectors for heating and cooling of buildings; New York, New York, USA (21 Nov 1974).

In Proceedings of the workshop on solar collectors for heating and cooling of buildings.

This brief review is of data requirements and some of the accepted measurement techniques which have been developed primarily in the thermophysics field for thermal control applications. Data requirements can generally be classified into three categories. The thermophysical properties include thermal conductivity, specific heat, and the thermal radiative characteristics. Physical properties cover the density, tensile strength, melting point, and other common properties. The environmental resistance of materials to solar ultraviolet radiation, moisture and possible pollutant gases are particularly significant for collector materials. (WDM)

6594 (NSF-RA-N—75-019, pp 369-372) **Development of a performance specification for solar collectors.** Hartman, D.L. (Dubin-Mindell-Bloome Associates, New York). May 1975.

From Workshop on solar collectors for heating and cooling of buildings; New York, New York, USA (21 Nov 1974).

In Proceedings of the workshop on solar collectors for heating and cooling of buildings.

The basic areas covered in a performance specification are thermal and mechanical. Thermal performance includes day-long heat collection BTU/ft² and instantaneous efficiency (percent). Mechanical performance includes materials, construction details and durability. Together these specify a state-of-the-art collector that can be constructed in late 1975. (WDM)

6595 (NSF-RA-N—75-019, pp 373-379) **Solar collector testing by calorimetry.** Lee, W.D. (Arthur D. Little, Inc., Cambridge, MA). May 1975.

From Workshop on solar collectors for heating and cooling of buildings; New York, New York, USA (21 Nov 1974).

In Proceedings of the workshop on solar collectors for heating and cooling of buildings.

A simple method for measuring solar collector performance using calorimetry is described. (WDM)

6596 (NSF-RA-N—75-019, pp 391-400) **Status of the NASA-Lewis flat-plate collector tests with a solar simulator.** Simon, F.F. (NASA, Lewis Research Center, Cleveland). May 1975.

From Workshop on solar collectors for heating and cooling of buildings; New York, New York, USA (21 Nov 1974).

In Proceedings of the workshop on solar collectors for heating and cooling of buildings.

The approach being taken at the Lewis Research Center for determining collector performance is to test collectors under simulated (indoor) and actual (outdoor) conditions. This paper reports the results to date of the collectors tested at Lewis under simulated sun conditions. The initial results reported in NASA-TM-X-7/602 are included herein as part of the status report. (auth)

6597 (NSF-RA-N—75-019, pp 401-406) **Solar collector performance evaluated outdoors at NASA-Lewis Research Center.** Vernon, R.W. (NASA, Lewis Research Center, Cleveland). May 1975.

From Workshop on solar collectors for heating and cooling of buildings; New York, New York, USA (21 Nov 1974).

In Proceedings of the workshop on solar collectors for heating and cooling of buildings.

6598 (NSF-RA-N—75-019, pp 407-410) **Survey of coatings for solar collectors.** McDonald, G.E. (NASA, Lewis Research Center, Cleveland). May 1975.

From Workshop on solar collectors for heating and cooling of buildings; New York, New York, USA (21 Nov 1974).

In Proceedings of the workshop on solar collectors for heating and cooling of buildings.

Ceramic enamel is more solar selective, (i.e., has high solar absorptance in combination with low infrared emittance) than organic enamel, but neither is as solar selective as black chrome, black copper, black zinc, or black nickel. Ceramic enamel is matched only by black chrome in durability and wide availability. Ceramic enamel and organic enamel have approximately the same cost, and both are currently slightly lower in cost than black chrome, black copper, or black zinc. Black nickel is relatively unavailable and, because of that, realistic cost comparisons are not possible. (auth)

6599 (NSF-RA-N—75-019, pp 383-390) **Summary of NASA-Marshall residential solar collector experiments.** Dabbs, J.R. (NASA-Marshall Space Flight Center, Huntsville, AL). May 1975.

From Workshop on solar collectors for heating and cooling of buildings; New York, New York, USA (21 Nov 1974).

In Proceedings of the workshop on solar collectors for heating and cooling of buildings.

A summary of the current Marshall Space Flight Center solar collector efforts and some planned follow-on activities are presented. (WDM)

6600 (PB—242258) **Solar energy concentration. Annual progress report, 1 July—31 December 1974.** (Argonne National Lab., Ill. (USA)). 31 Jan 1974. 128p. (NSF/RA/N—75-024). NTIS $5.25.

A concentrating solar heater based on the compound parabolic design was constructed and tested. The principle characteristics of the collector are that it has a concentration factor = 3, and an angular acceptance (full angle) = 38 degrees: The large angular acceptance implies that bi-annual adjustment of the collector orientation is sufficient to accept direct solar radiation. Experimental results from outdoor tests show good agreement with theory and confirm the expected improvement in performance resulting from concentration. Such performance would be useful for space conditioning applications in a temperature range where flat plate collectors are marginal (130F above ambient). (auth)

6601 (PB—242935) **Heliostat mount. Final invention disclosure.** Applebaugh, C.R. (McDonnell Douglas Corp., Santa Monica, Calif. (USA)). 1975. 6p. (NSF—75-72-GI-39456). NTIS $3.25.

This device is designed to support and move a large reflector in such a way that the reflection of the sun or other moving object is directed to a fixed target point located at any position in the hemisphere above the horizon. The device must have sufficient strength and rigidity to maintain the reflected image accurately on the target point under wind gust conditions. This device provides a stronger, more rigid design than present devices to maintain accurate positioning under wind loading. (auth)

6602 **Collection and conversion of solar energy.** Murray, E.L. pp 149-163 of In Physics and the energy industry. Summer school in physics. Bedford Park, South Australia; Flinders University (1974).

From Summer school on physics and the energy industry; Bedford Park, Australia (Jan 1974).

See CONF-740137—.

Availabilit, of solar radiation for utilization as low/medium grade heat is discussed. The principles of solar absorbers and collectors are summarized. Some data are presented on solar flux measurements at various places in Australia. (WDM)

6603 **Performance of transparent glass honeycombs in flat plate collectors.** Baldwin, C.M.; Dunn, B.S.; Hilliard, W.G.; Mackenzie, J.D. (Univ. of California, Los Angeles). pp 206 of In 1975 International Solar Energy Congress and Exposition. Rockville, MD; International Solar Energy Society (1975).

From Annual meeting of the International Solar Energy Society; Los Angeles, California, USA (28 Jul 1975).

See CONF-750712—.

6604 **End-clearance effects on rectangular-honeycomb solar collectors.** Edwards, D.K.; Arnold, J.N.; Catton, I. (Univ. of California, Los Angeles). pp 209-210 of In 1975 International Solar Energy Congress and Exposition. Rockville, MD; International Solar Energy Society (1975).

From Annual meeting of the International Solar Energy Society; Los Angeles, California, USA (28 Jul 1975).

See CONF-750712—.

6605 **Design considerations for solar collectors with glass cylindrical cellular covers.** Buchberg, H.; Edwards, D.K.; Mackenzie, J.D. (Univ. of California, Los Angeles). pp 224-225 of In 1975 International Solar Energy Congress and Exposition. Rockville, MD; International Solar Energy Society (1975).

From Annual meeting of the International Solar Energy Society; Los Angeles, California, USA (28 Jul 1975).

See CONF-750712—.

6606 **Method of testing for rating solar collectors based on thermal performance.** Streed, E.R.; Hill, J.E. (National Bureau of Standards, Washington, DC). pp 227-228 of In 1975 International Solar Energy Congress and Exposition. Rockville, MD; International Solar Energy Society (1975).

From Annual meeting of the International Solar Energy Society; Los Angeles, California, USA (28 Jul 1975).

See CONF-750712—.

6607 **Flat-plate solar-collector performance evaluation with a solar simulator as a basis for collector selection and performance**

prediction. Simon, F.F. (Lewis Research Center, Cleveland). pp 233-234 of In 1975 International Solar Energy Congress and Exposition. Rockville, MD; International Solar Energy Society (1975).

From Annual meeting of the International Solar Energy Society; Los Angeles, California, USA (28 Jul 1975).

See CONF-750712—.

6608 Status report of outdoor solar collector tests at the NASA-Lewis Research Center. Vernon, R.W. (Lewis Research Center, Cleveland). pp 235-236 of In 1975 International Solar Energy Congress and Exposition. Rockville, MD; International Solar Energy Society (1975).

From Annual meeting of the International Solar Energy Society; Los Angeles, California, USA (28 Jul 1975).

See CONF-750712—.

6609 LASL structurally integrated solar collector unit: final results. Balcomb, J.D.; Hedstrom, J.C.; Moore, S.W. pp 241a of In 1975 International Solar Energy Congress and Exposition. Rockville, MD; International Solar Energy Society (1975).

From Annual meeting of the International Solar Energy Society; Los Angeles, California, USA (28 Jul 1975).

See CONF-750712—.

6610 Nonconvecting solar pond: some applications and stability problem areas. Styris, D.L. (Battelle Pacific Northwest Labs., Richland, WA); Zaworski, R.J.; Harling, O.K.; Leshuk, J. (Battelle Pacific Northwest Labs., Richland, WA). pp 265-266 of In 1975 International Solar Energy Congress and Exposition. Rockville, MD; International Solar Energy Society (1975).

From Annual meeting of the International Solar Energy Society; Los Angeles, California, USA (28 Jul 1975).

See CONF-750712—.

6611 Experimental performance of shallow solar ponds. Clark, A.F. (Lawrence Livermore Lab., CA); Ahlgren, W.L.; Day, J.A.; Dickinson, W.C.; Gensler, W.G. pp 269 of In 1975 International Solar Energy Congress and Exposition. Rockville, MD; International Solar Energy Society (1975).

From Annual meeting of the International Solar Energy Society; Los Angeles, California, USA (28 Jul 1975).

See CONF-750712—.

6612 Operation of a small salt gradient solar pond. Nielsen, C.E. (Ohio State Univ., Columbus); Rabl, A. pp 271-272 of In 1975 International Solar Energy Congress and Exposition. Rockville, MD; International Solar Energy Society (1975).

From Annual meeting of the International Solar Energy Society; Los Angeles, California, USA (28 Jul 1975).

See CONF-750712—.

6613 Desert tests of a 3.7m square heliostat. Blackmon, J.B. (McDonnell Douglas Astronautics West, Huntington Beach, CA); Vant-Hull, L.L.; Hildebrandt, A.F. pp 456-457 of In 1975 International Solar Energy Congress and Exposition. Rockville, MD; International Solar Energy Society (1975).

From Annual meeting of the International Solar Energy Society; Los Angeles, California, USA (28 Jul 1975).

See CONF-750712—.

6614 Statistical approach to the solar flux density calculation for a tower-top solar concentrator. Lipps, F.W.; Vant-Hull, L.L.; Walzel, M. (Univ. of Houston, TX). pp 472-473 of In 1975 International Solar Energy Congress and Exposition. Rockville, MD; International Solar Energy Society (1975).

From Annual meeting of the International Solar Energy Society; Los Angeles, California, USA (28 Jul 1975).

See CONF-750712—.

6615 Test results from a parabolic-cylindrical solar collector. Treadwell, G.W.; McCulloch, W.H.; Rusk, R.S. (Sandia Labs., Albuquerque, NM). pp 479-480 of In 1975 International Solar Energy Congress and Exposition. Rockville, MD; International Solar Energy Society (1975).

From Annual meeting of the International Solar Energy Society; Los Angeles, California, USA (28 Jul 1975).

See CONF-750712—.

6616 Performance analysis of a cylindrical parabolic focusing collector and comparison with experimental results. Edenburn, M.W. (Sandia Labs., Albuquerque, NM). pp 481-482 of In 1975 International Solar Energy Congress and Exposition. Rockville, MD; International Solar Energy Society (1975).

From Annual meeting of the International Solar Energy Society; Los Angeles, California, USA (28 Jul 1975).

See CONF-750712—.

6617 Linear fresnel lens concentrators. Nelson, D.T. (Luther College, Decorah, IA); Evans, D.L.; Bansal, R.K. pp 483-484 of In 1975 International Solar Energy Congress and Exposition. Rockville, MD; International Solar Energy Society (1975).

From Annual meeting of the International Solar Energy Society; Los Angeles, California, USA (28 Jul 1975).

See CONF-750712—.

6618 Development and testing of a 540 ft² faceted fixed mirror concentrator. Williams, J.R. (Georgia Inst. of Tech., Atlanta); Hutchins, S.F. pp 491-492 of In 1975 International Solar Energy Congress and Exposition. Rockville, MD; International Solar Energy Society (1975).

From Annual meeting of the International Solar Energy Society; Los Angeles, California, USA (28 Jul 1975).

See CONF-750712—.

6619 Solar heated air receivers. Jarvinen, P.O. (Massachusetts Inst. of Tech., Lexington). pp 493-494 of In 1975 International Solar Energy Congress and Exposition. Rockville, MD; International Solar Energy Society (1975).

From Annual meeting of the International Solar Energy Society; Los Angeles, California, USA (28 Jul 1975).

See CONF-750712—.

6620 Turning collectors: a compromise between stationary and heliostatic ones. Barak, A.Z. (Argonne National Lab., IL). pp 497-498 of In 1975 International Solar Energy Congress and Exposition. Rockville, MD; International Solar Energy Society (1975).

From Annual meeting of the International Solar Energy Society; Los Angeles, California, USA (28 Jul 1975).

See CONF-750712—.

6621 Compound parabolic concentrator. Giugler, R.; Rabl, A.; Sevcik, V.J.; Winston, R. (Argonne National Lab., IL). pp 506-507 of In 1975 International Solar Energy Congress and Exposition. Rockville, MD; International Solar Energy Society (1975).

From Annual meeting of the International Solar Energy Society; Los Angeles, California, USA (28 Jul 1975).

See CONF-750712—.

GEOTHERMAL ENERGY

RESOURCES AND AVAILABILITY

USA

6622 (CONF-750612—) **First geopressured geothermal energy conference, Austin, Texas, June 2—4, 1975.** Dorfman, M.H.; Deller, R.W. (eds.). (Texas Univ., Austin (USA)). 1975. 363p. Dep. NTIS $10.50.

From 1. geopressured geothermal energy conference; Austin, Texas, USA (2 Jun 1975).

Fifteen papers and a summary discussion are included in the Proceedings. A separate abstract was prepared for each. (LS)

6623 (CONF-750612—, pp 173-192) **Energy potential of geopressured reservoirs: hydrogeologic factors.** Papadopulos, S.S. (Geological Survey, Reston, VA). 1975.

From 1. geopressured geothermal energy conference; Austin, Texas, USA (2 Jun 1975).

In First geopressured geothermal energy conference.

The energy potential of geothermal waters in the geopressured reservoirs of the Gulf Coast ultimately depends on the yield of wells tapping these reservoirs. An analysis is made to determine possible well yields in a geopressured reservoir in Hidalgo County, Texas. The average pressure-to-depth ratio in the reservoir is 17 kilonewtons per square metre per metre. The average temperature

of the water is 135°C (275°F), and the average salinity is about 25,000 milligrams per litre. The average methane content is estimated to be 4.8 standard cubic meters per cubic metre. Based on an idealized model of the reservoir, the results of the analysis indicate that a single 0.23-metre diameter well at the center of the reservoir could sustain a flow rate of 0.31 cubic metre per second for 20 years. The total production rate from the reservoir could be increased to 2.7 cubic metres per second for the 20-year period by assuming that a minimum flow rate of 0.15 cubic metre per second per well is satisfactory and by developing the reservoir with 18 wells atoptimum spacing. The thermal, mechanical, and methane energy contained in the waters produced with the 18-well development scheme is equivalent to 11.32×10^{17} joules. The thermal and mechanical energy components of this total could be converted to 94 megawatts of electrical power over the 20-year production period. The sensitivity of well yields to hydrogeologic factors is also examined. It is concluded that the most important hydrogeologic factor in the development of geopressured reservoirs is the transmissivity. The results of calculations made for this sensitivity determination are presented graphically and can be used to make quick estimates of the yield of wells tapping geopressured reservoirs. (auth)

6624 (CONF-750612—, pp 283-297) **Potential power generation and gas production from Gulf Coast geopressured reservoirs.** House, P.A.; Johnson, P.M.; Towse, D.F. (Univ. of California, Livermore). 1975.

From 1. geopressured geothermal energy conference; Austin, Texas, USA (2 Jun 1975).

In First geopressured geothermal energy conference.

Extensive on-shore and offshore zones of geopressured water reservoirs are found in the Texas and Louisiana Gulf Coast region. Energy in these reservoirs is present in the form of natural gas in solution, thermal energy, and hydraulic energy. Reservoir depths generally vary from 5000 to 20,000 feet, with corresponding temperatures from below 200°F to above 300°F. Natural gas is presumed to exist at saturation levels in the reservoirs. Total-flow, flashed-stream, and binary-cycle thermal energy conversion systems were investigated as a means to utilize the thermal energy. The total-flow system was selected for a detailed power-plant systems analysis. Powerplant net power output was determined for both surface and injection disposal of the waste water. The range of electrical and gas output from 7-inch nominal production wells is from 0.36 megawatts (Mw) and 6.4 standard cubic feet per second (scf/sec) to 6.2 Mw and 39.9 scf/sec. The lowest values are for the shallow reservoirs with fluid disposal by injection, and the higher values are for the deepest reservoirs with surface disposal. The shallow reservoirs would not be profitable for combined gas production and electrical-power generation, but might be profitable for gas production alone. Deeper reservoirs would be profitable for combined gas production and power generation. The class of deepest reservoirs, without the presence of gas, would be marginally profitable for electrical generation alone.

6625 (CONF-750612—, pp 337-362) **Panel discussion: summation and future projections.** 1975.

From 1. geopressured geothermal energy conference; Austin, Texas, USA (2 Jun 1975).

In First geopressured geothermal energy conference.

A panel discussion is presented which summarizes the technology development and future projections for geopressured geothermal resources. (LS)

SITE GEOLOGY, HYDROLOGY, AND METEOROLOGY

USA

6626 (CONF-750612—, pp 15-89) **Geothermal and hydrocarbon regimes, northern Gulf of Mexico basin.** Jones, P.H. (Louisiana State Univ., Baton Rouge). 1975.

From 1. geopressured geothermal energy conference; Austin, Texas, USA (2 Jun 1975).

In First geopressured geothermal energy conference.

Geothermal heat flow in the Gulf basin is primarily a function of its hydrology. Water expelled from sediments with deepening burial and increasing overburden load escapes upward and toward the basin margin. Where it moves freely in the hydropressure zone, the basin is relatively cool; but where rapid sedimentation and contemporaneous faulting have retarded water loss from compacting sediments, the interstitial fluid pressure reflects a part of the overburden load, and the formation waters are superheated and geopressured. The geopressured zone is common below depths of about 3 km (9,600 ft) in the basin, beneath an area of 375,000 km² (150,000 mi²), and extends downward perhaps 15 km (50,000 ft) to the base of Cenozoic deposits. The upper boundary of the geopressured zone is the most important physical interface in the basin. Across it the head of formation water increases downward from a few hundred to several thousand feet above sea level; the geothermal gradient increases downward from 20° to 40°C/km to 100°C/km or more; the salinity of formation water decreases downward, commonly by 50,000 mg/l or more; and the porosity of shale and sand increases downward by 10 to 25 percent. Petroleum matures in geopressured clay at 140° to 220°F. Montmorillonite is dehydrated at 180° to 250°F; fresh water released may equal half the volume of the mineral altered. Molecular solubility in fresh water of the hydrocarbons in Gulf basin crude,under geopressured zone conditions, could account for petroleum resources of the basin. Exsolution of petroleum hydrocarbons near the geopressured zone boundary could account for observed occurrences. This geopressured zone is a natural pressure vessel from which superheated water of moderate salinity could be produced through wells, each yielding millions of gallons a day at pressures of several thousand pounds per square inch, and temperatures above 300°F, with considerable amounts of methane gas in solution. (auth)

6627 (CONF-750612—, pp 101-130) **Regional sand distribution of the Frio Formation, South Texas: a preliminary step in prospecting for geothermal energy.** Bebout, D.G.; Agagu, O.K.; Dorfman, M.H. 1975.

From 1. geopressured geothermal energy conference; Austin, Texas, USA (2 Jun 1975).

In First geopressured geothermal energy conference.

A geologic study is made of the main sand trends of the Frio formation. Three major Frio sand depocenters have been delineated: (1) Southeastern Hidalgo, Western Willacy, and Western Cameron Counties; (2) Eastern Kenedy and Kleberg Counties; and (3) North-Central Nueces County. Sand percentage maps were made based on data obtained from the interpretation of the spontaneous potential curve of 232 electric logs of wells spaced approximately 5 to 10 miles apart throughout the South Texas area. Potential geothermal areas were delineated from correlations of isothermal and sand-percentage maps. (LS)

GEOTHERMAL EXPLORATION AND EXPLORATION TECHNOLOGY

GEOPHYSICAL TECHNIQUES AND SURVEYS

6628 (CONF-750525—16) **Geophysical papers submitted to the second U.N. symposium on the development and use of geothermal resources, San Francisco, California, May 20—29, 1975. Report No. 102.** Risk, G.F. (comp.). (Department of Scientific and Industrial Research, Wellington (New Zealand)). May 1975. 160p. Dep. NTIS (US Sales Only) $7.75.

From 2. United Nations symposium on the development and uses of geothermal resources; San Francisco, California, USA (20 May 1975).

Six papers submitted to the Second U. N. Symposium on the Development and Use of Geothermal Resources are included. A separate abstract was prepared for each paper. (LBS)

6629 (CONF-750525—16, pp 5-19) **Monitoring the boundary of the Broadlands geothermal field, New Zealand.** Risk, G.F. May 1975.

From 2. United Nations symposium on the development and uses of geothermal resources; San Francisco, California, USA (20 May 1975).

In Geophysical papers submitted to the second U.N. symposium on the development and use of geothermal resources.

A dipole-dipole resistivity array has been used to make close spaced resistivity traverses across the lateral boundary of the Broadlands geothermal field, New Zealand, in order to locate the boundary accurately and study its nature. The current electrodes of the array were sited about 1 km on either side of the boundary and the receiver array was traversed along lines crossing the boundary approximately at right angles. Measurements were made at intervals of 50 m. Along some traverse lines, the apparent resistivity changed abruptly from about 3 to 20 Ωm in a horizontal distance of less than 200 m. These abrupt changes and the observation of induced polarization effects near the boundary suggest that some parts of the boundary may comprise an impermeable physical barrier formed by deposition of chemicals from the geothermal brine. Since all the measurement points have been located relative to permanent survey marks, later repeat measurements will enable changes of location of the boundary due to inflow of cold or other causes to be monitored. (auth)

6630 (CONF-750525—16, pp 20-35) **Useful heat contained in the Broadlands geothermal field.** Macdonald, W.J.P. May 1975.

From 2. United Nations symposium on the development and uses of geothermal resources; San Francisco, California, USA (20 May 1975).

In Geophysical papers submitted to the second U.N. symposium on the development and use of geothermal resources.

Measurements in the Broadlands geothermal field indicate that below the casing at depths greater than 730 m the water is not boiling. It is inferred that the fall in temperature is caused by a lateral inflow of cold water. Because of this cold inflow it is possible to extract all of the useful heat (2.9×10^{18}J) stored in the rocks of the reservoir between depths of 600 m and 2600 m. This heat, together with the heat in the water of the reservoir and the small amount of heat introduced from below, should give a minimum for the generation of electric power of 200 MW for 47 years. (auth)

6631 (CONF-750525—16, pp 36-62) **Studies of the propagation and source location of geothermal seismic noise.** Whiteford, P.C. May 1975.

From 2. United Nations symposium on the development and uses of geothermal resources; San Francisco, California, USA (20 May 1975).

In Geophysical papers submitted to the second U.N. symposium on the development and use of geothermal resources.

Measurements of seismic noise (or ground movement) in the frequency range 1—7 Hz have been made in the Wairakei and Waiotapu geothermal fields, New Zealand, in order to determine the wave velocities and attenuation constants, study the nature of the waves, and locate the sources of noise. The wave velocities, measured using tripartite arrays of geophones, ranged from 150 to 900 m/s. The attenuation constants which were determined from measurements of ground particle velocity at a number of sites around a source varied between 3×10^{-4} m^{-1} and 3×10^{-3} m^{-1}. These values of velocity and attenuation constant are similar to values usually obtained for seismic waves in non-geothermal environments. From simultaneous measurements of the three components of the seismic noise it is shown that the waves are mostly surface waves. This conclusion is supported also by evidence from the velocity and attenuation studies. Sources were located from the patterns of the amplitude of ground particle velocity at closely spaced geophone sites and from observations of wave directions determined using tripartite arrays. Depths of sources were determined from ground particle velocity measurements by using a theoretical expression for attenuation versus distance. At Wairakei, studies of noise around the crater of a runaway rogue bore (No. 204) showed that the noise originated from a depth of about 100 m beneath the crater. At Waiotapu, several sources were located at similar depths beneath hot pools and other surface manifestations of activity. (auth)

6632 (CONF-750525—16, pp 63-77) **Assessment of the audio-magnetotelluric method for geothermal resistivity surveying.** Whiteford, P.C. May 1975.

From 2. United Nations symposium on the development and uses of geothermal resources; San Francisco, California, USA (20 May 1975).

In Geophysical papers submitted to the second U.N. symposium on the development and use of geothermal resources.

The audio-frequency magnetotelluric (AMT) method of measuring earth resistivities was tested in the Broadlands geothermal field, New Zealand, and found to be a time-saving method for making regional resistivity surveys. The equipment consists of two General Radio Type 1232A amplifier-filters with additional locally made amplifiers, filters, integrators, electrodes and a ferrite-cored coil. It operates between frequencies of 8 Hz and 1800 Hz. Comparison of the AMT apparent resistivities with those obtained from several previous resistivity surveys of Broadlands shows agreement within a factor of 2 or 3. Apparent resistivities measured inside the field were about 2 to 12 Ωm and those outside the field greater than about 60 Ωm. The position of the sharp boundary of the field found by the AMT method agreed with that of previous surveys. Resistivity soundings made at three sites using both the AMT and Schlumberger methods showed some agreement but there was more scatter on the AMT sounding curves. Apparent resistivities within the geothermal field obtained at frequencies above 300 Hz were influenced by a thin higher resistivity surface layer and therefore lower frequencies are more useful. At some sites AMT measurements were repeated several times and the results were found to vary with standard deviations about the mean of 60 percent for sites inside the geothermal area and 30 percent for sites outside. Interference from 50 Hz power lines could be eliminated satisfactorily using rejection filters but noise from electrical interference, both natural and man-made, and noise from wind and rain proved troublesome. (auth)

6633 (CONF-750525—16, pp 78-100) **Detection of buried zones of fissured rock in geothermal fields using resistivity anisotropy measurements.** Risk, G.F. May 1975.

From 2. United Nations symposium on the development and uses of geothermal resources; San Francisco, California, USA (20 May 1975).

In Geophysical papers submitted to the second U.N. symposium on the development and use of geothermal resources.

If the rock of a geothermal hot water reservoir has a regular set of parallel plane fissures filled with conductive hot water, its resistivity is likely to be strongly anisotropic. An attempt has been made to use this effect to locate buried fracture zones in a region, 1.6 square kilometers in area, within the Broadlands geothermal field, New Zealand. Using current electrodes outside the region of study, current was passed through the region in six different directions and the resulting electric field strengths were measured at 58 receiver sites. Over the thickest part of a buried rhyolite dome beneath the study area isotropic apparent resistivities of about 15 Ωm were obtained but over the flanks of the dome the apparent resistivities were strongly anisotropic, varying with direction from about 3 to 15 Ωm. Schlumberger resistivity soundings display a similar pattern and suggest that the anisotropic rocks lie beneath the rhyolite at depths greater than 200 m. Of 15 wells in the study area, some of the most productive ones were drilled into the anisotropic zone. A possible explanation for the anisotropy is that stresses imposed during the eruption of the rhyolite have caused radial fracturing of the rock around the eruptive vent. (auth)

6634 (CONF-750525—16, pp 101-120) **Airborne infra-red survey of the Tauhara geothermal field, New Zealand.** Dickinson, D.J. May 1975.

From 2. United Nations symposium on the development and uses of geothermal resources; San Francisco, California, USA (20 May 1975).

In Geophysical papers submitted to the second U.N. symposium on the development and use of geothermal resources.

An airborne infrared survey has been flown over urban, industrial and undeveloped land in the Tauhara and some other geothermal fields in New Zealand using an Aga Thermovision model 665 camera, operating in the 4.5 to 5.5 μm band. Maps have been prepared from the thermograms which divide the surface temperatures into three ranges, at ambient temperature, 1-3°C above ambient and more than 3°C above ambient. The 3°C contour coincides with the boundary between regions of conductive and convective heat flow determined from surface measurements. Methods have been developed for determining the heat flow from the infra-red and other data. Some previously unknown areas of warm ground have been discovered and some thermal anomalies of non-geothermal origin identified and their effects eliminated. To assist the planning of industrial and urban development, it is intended to conduct similar surveys at approximately three yearly intervals to monitor any changes of the hydrothermal activity. (auth)

6635 (CONF-750612—, pp 133-147) **Reflection seismic techniques locate geopressured geothermal anomalies.** Aud, B.W. (Dresser Industries, Inc., Houston, TX). 1975.

From 1. geopressured geothermal energy conference; Austin, Texas, USA (2 Jun 1975).

In First geopressured geothermal energy conference.

Interpretive techniques for predicting abnormal pressure and relative lithology from velocity analysis of seismic data are outlined. By use of correlations between high temperature and abnormal pressure zones, these techniques can be applied to the exploration of geopressured geothermal anomalies. (LS)

REGULATIONS

6636 (CONF-750612—, pp 327-330) **Role of public lands in geothermal energy.** Armstrong, B. (General Land Office, Austin, TX). 1975.

From 1. geopressured geothermal energy conference; Austin, Texas, USA (2 Jun 1975).

In First geopressured geothermal energy conference.

A brief discussion is given on legal aspects of leasing of public lands for the development of geothermal resources within the State of Texas. The land commissioner of the State of Texas is charged with the management of some 22 million acres of state land. The legal aspects of 8 million acres of relinquishment act lands, of which the surface owner is the agent for the state in terms of leasing, are considered. (LS)

ECONOMICS

6637 (CONF-750612—, pp 267-279) **Economic analysis of the use of Texas geopressured geothermal resources for the produc-**

tion of electrical power. Wilson, J.S. (Dow Chemical Co., Freeport, TX); Shepherd, B.P.; Kaufman, S. 1975.

From 1. geopressured geothermal energy conference; Austin, Texas, USA (2 Jun 1975).

In First geopressured geothermal energy conference.

Two geopressured geothermal-reservoir sands in South Texas were identified and described. Power production from these reservoirs was evaluated, using both flash and secondary-fluid systems. Results indicated water yields sufficient to power a 25-Mw plant in one reservoir and a 60-Mw plant in the second. Economics of the plants were most favorable in the latter, where a two-flash system gave power at 26.8 mils per kilowatt hour as compared to the secondary isobutane system at 33.3 mils per kilowatt hour. Both values assume credit for 30 scf methane per barrel of water. Power-cost calculations show this power to be competitive for 50-Mw and larger plants as 20 percent return on investment. Using 15 percent return on investment, this power source is shown to be very competitive. All costs are given on a 1980 basis assuming a 5 percent annual inflation rate. (auth)

ENVIRONMENTAL ASPECTS

6638 (CONF-750612—, pp 311-318) **Environmental problems associated with power production from geopressured reservoirs.** Herrin, E.; Goforth, T. (Southern Methodist Univ., Dallas). 1975.

From 1. geopressured geothermal energy conference; Austin, Texas, USA (2 Jun 1975).

In First geopressured geothermal energy conference.

Various environmental problems that may arise in the exploration for and exploitation of geopressured reservoirs are considered. A particular reservoir in northwest Cameron County, Texas is used as a model. Subsidence effects, tectonic activity, and induced activity are discussed. It is concluded that two important environmental problems cannot be adequately evaluated at this time: surface subsidence and the possible inducement of earthquakes, which could result from the efficient production of power over the lifetime of a reservoir. (LS)

6639 (CONF-750612—, pp 321-324) **Environmental considerations and economic implications in the development of geothermal energy.** Moseley, F.N. (Central Power and Light Co., Corpus Christi, TX). 1975.

From 1. geopressured geothermal energy conference; Austin, Texas, USA (2 Jun 1975).

In First geopressured geothermal energy conference.

The role of economics in determining the feasibility of developing a new resource from both a technological and environmental viewpoint is illustrated. It is pointed out that general environmental guidelines should be developed during the research phase of geopressured geothermal development. It is suggested that during the initial phase of geothermal exploration, consideration should be given to environmental problems that may be associated with the development, choices available in working with these problems, techniques that could be employed, and environmental responses to the various alternatives. (LS)

GEOTHERMAL ENGINEERING

6640 (CONF-750612—, pp 263-264) **Heat exchanger performance with low-salinity geothermal brines.** Hinrichs, T. (Magma Power Co., Escondido, CA). 1975.

From 1. geopressured geothermal energy conference; Austin, Texas, USA (2 Jun 1975).

In First geopressured geothermal energy conference.

Portable, small-scale heat exchanger testing units were used to evaluate heat exchanger performance for low-salinity brines in the Imperial Valley field. One unit involves four shell-and-tube heat exchangers operating in series. Another involves one tube and four shell-and-tube heat exchangers in series. In addition to the overall heat exchanger performance, the effects of brine temperature were also studied. It is suggested that a test device should be used to supplement any well testing in geopressured zones to establish the heat exchanger performance for these reservoirs. (LS)

DRILLING TECHNIQUES AND WELL HARDWARE

6641 (CONF-750612—, pp 193-204) **Well-information systems as applied to geopressured reservoir description.** Young, F.S. (NL Industries, Houston, TX). 1975.

From 1. geopressured geothermal energy conference; Austin, Texas, USA (2 Jun 1975).

In First geopressured geothermal energy conference.

Some of the problems encountered in drilling for indigenous energy sources include high temperature and pressure, unstable rock formations, and severe drilling-fluid contamination. To avert the consequences of many of these occurrences, elaborate and sophisticated systems have been developed to monitor the drilling operation and provide sufficient forewarning to ensure operational safety. In addition, valuable quantitative information is generated during the monitoring process, which can be used to describe subsurface structural features, the nature of pore fluids, and certain basic rock properties useful in reservoir engineering. A brief discussion of contemporary well-information systems. Equipment and procedures useful for geopressured reservoir description are emphasized. (LS)

WELL PERFORMANCE

6642 (CONF-750612—, pp 157-169) **Reservoir mechanics of geopressured aquifers.** Bernard, W.J. (Louisiana State Univ., Baton Rouge). 1975.

From 1. geopressured geothermal energy conference; Austin, Texas, USA (2 Jun 1975).

In First geopressured geothermal energy conference.

To evaluate the practicality of producing energy from geopressured aquifers, methods to predict energy-production rates are necessary. A review is given of the established petroleum-reservoir engineering techniques as applied to geopressured systems. Also, the effects of dissolved natural gas, shale water influx, and abnormally high rock compressibilities on aquifer behavior are discussed. (auth)

6643 (CONF-750612—, pp 207-215) **Drill-stem testing and sampling of deep Frio and Wilcox reservoirs.** Montgomery, J.M. (Halliburton Services Research, Duncan, OK). 1975.

From 1. geopressured geothermal energy conference; Austin, Texas, USA (2 Jun 1975).

In First geopressured geothermal energy conference.

Methods of sampling and evaluating geopressured geothermal aquifers in extreme South Texas are discussed. The area of investigation includes Starr, Hidalgo, Kenedy, Willacy, and Cameron counties in the Texas valley and covers representative methods of evaluating the Frio formation (Oligocene) and the Wilcox formation (Eocene). (auth)

6644 (CONF-750612—, pp 217-225) **Numerical simulation of geopressured geothermal reservoirs.** Knapp, R.M.; Riney, T.D. 1975.

From 1. geopressured geothermal energy conference; Austin, Texas, USA (2 Jun 1975).

In First geopressured geothermal energy conference.

The governing equations describing mass and energy transport in geopressured geothermal reservoirs are discussed. A fully interacting rock-fluid system with rock porosity, permeability, and thermal conductivity dependent on the fluid and rock stresses is considered. The mathematical model includes the effects of solution and free natural gas. Sample calculations of a hypothetical hydrothermal reservoir are presented to show the applicability of reservoir simulation. (auth)

ARTIFICIAL STIMULATION

6645 (LA—6170-MS) **Forced oscillations of the Los Alamos Scientific Laboratory's dry hot rock geothermal reservoir.** Hsu, Y.C. (Los Alamos Scientific Lab., N.Mex. (USA)). Nov 1975. Contract W-7405-ENG-36. 6p. Dep. NTIS $4.50.

Equations of motion are derived for the Los Alamos Scientific Laboratory's geothermal reservoir consisting of an elastic half-space (rock), with an open vertical pipe from the surface connected at depth with a vertical penny-shaped fracture. This reservoir, which is filled with water (laminar flow through a pipe), is subjected to seismic waves and/or blast-like impulses applied downhole. Oscillations (responses) of the water column, of the downhole internal net pressure required to keep the fracture open, and of the fracture itself, are found for the reservoir. If the fracture is continuously oscillated subject to pressure waves applied downhole and failure of the fracture surface occurs, it is usually through fatigue after a long period of time. Of concern next is transient oscillation of the fracture when down-hole blast-like impulses are applied. Of particular concern is the maximum amplitude, G/sub max/, of the fracture (crack) oscillation in early cycles. Generally, failure due to G/sub max/ is attributed singly to the strength of the fractured rock being exceeded. Since the period, tau, of the oscillations is sensitive to the radius, R, of the fracture, experimental determination of tau, in conjunction with Eq. (20), will permit R to be evaluated accurately. (auth)

ENERGY UTILIZATION

6646 (CONF-750612—, pp 233-260) **Geothermal resource utilization: paper and cane sugar industries.** Hornburg, C.D. (DSS Engineers, Inc., Ft. Lauderdale, FL). 1975.

From 1. geopressured geothermal energy conference; Austin, Texas, USA (2 Jun 1975).

In First geopressured geothermal energy conference.

The feasibility of utilizing geothermal resources of the geopressured zone along the Gulf of Mexico Coast in the pulp and paper industry and sugar cane industry was studied. A summary of the findings is presented, which includes energy requirements, specific plants and sites, diagrams of main processes, energy-recovery system, waste disposal and economics. The overall conclusion of the study is that utilization of thermal energy from the geoenergy fluid in pulp and paper mills and new sugar refineries is technically sound and economically viable, provided that the other energy in the fluid (natural gas and pressure) is recovered concurrently. (LS)

TIDAL POWER

ENVIRONMENTAL ASPECTS

6647 (ERDA—110(Vol.2)) **Federal inventory of energy-related biomedical and environmental research for FY 1974 and FY 1975. Project abstracts. Volume II.** (Energy Research and Development Administration, Washington, D.C. (USA). Div. of Biomedical and Environmental Research). Oct 1975. 629p. Dep. NTIS $13.60.

6648 (ERDA—110(Vol.4)) **Federal inventory of energy-related biomedical and environmental research for FY 1974 and FY 1975.** (Energy Research and Development Administration, Washington, D.C. (USA). Div. of Biomedical and Environmental Research). Oct 1975. 511p. Dep. NTIS $10.00.

Brief summaries are presented of energy-related biomedical and environmental research studies during 1974 and 1975 sponsored by the Tennessee Valley Authority, National Aeronautics and Space Administration, National Institutes of Health, and the National Institute for Occupational Safety and Health. (CH)

ELECTRIC POWER ENGINEERING

POWER GENERATION

6649 (CONF-750867—, pp 36-49) **Optimal power dispatch.** Happ, H.H. (General Electric Co., Schenectady, NY). 1975.

From Proceedings on systems engineering for power; Henniker, New Hampshire, USA (17 Aug 1975).

In Systems engineering for power: status and prospects, Henniker, New Hampshire, August 17—22, 1975.

The progress of optimal dispatch also called economic dispatch, since its inception to the present time is reviewed in a chronological sequence. Economic dispatch is used in real time control to allocate the total generation among the units available to take on load, in interchange evaluation, in interchange costing and billing, in unit commitment, etc. Directions the industry is taking with respect to developments in economic dispatch as well as its implementation are reported, as well as recommendations of future work in this area. (LCL)

6650 (CONF-750867—, pp 52-84) **Control interfaces in generation allocation.** Zaborszky, J.; Subramanian, A.K.; Lu, K.M. (Washington Univ., St. Louis). 1975.

From Proceedings on systems engineering for power; Henniker, New Hampshire, USA (17 Aug 1975).

In Systems engineering for power: status and prospects, Henniker, New Hampshire, August 17—22, 1975.

The systemwide generation allocation problem is defined and its customary subdivisions, geographical, hierarchical, modal and functional are identified. Functional areas of control action are noted and the control practices within these areas and especially on the interfaces are observed and discussed. The necessity, progress and potential direction of a rethinking of the interfaces and their control is discussed. (auth)

6651 (CONF-750867—, pp 116-126) **Unit commitment scheduling of electric power systems.** Gruhl, J.; Schweppe, F.; Ruane, M. (MIT Energy Lab., Cambridge, MA). 1975.

From Proceedings on systems engineering for power; Henniker, New Hampshire, USA (17 Aug 1975).

In Systems engineering for power: status and prospects, Henniker, New Hampshire, August 17—22, 1975.

The role of a unit commitment scheduler is to provide a power system with hour-by-hour strategies for committing and withdrawing generating units in an economic and reliable manner. This survey paper defines the scope and principal features of unit commitment, considers the alternative approaches, and outlines the potential areas for further research in this field. (auth)

6652 (CONF-750867—, pp 144-172) **Security assessment of power systems.** Debs, A.S. (Georgia Inst. of Tech., Atlanta); Benson, A.R. 1975.

From Proceedings on systems engineering for power; Henniker, New Hampshire, USA (17 Aug 1975).

In Systems engineering for power: status and prospects, Henniker, New Hampshire, August 17—22, 1975.

A review of the state of the art in assessing the security of power system operations is provided. Emphasis is placed on the overall philosophy of preventive system operation, and the computational and data acquisition systems required for on-line monitoring and analysis of system security. Critical comparison of various approaches is provided. Recommendations for effective security assessment for a single company, as well as an interconnection, are provided. Furthermore, industry practices and guidelines in the area of system security are presented and commented upon. (auth)

6653 (CONF-750867—, pp 177-193) **Security enhancement for power systems.** Hajdu, L.P.; Podmore, R. (Systems Control, Inc., Palo Alto, CA). 1975.

From Proceedings on systems engineering for power; Henniker, New Hampshire, USA (17 Aug 1975).

In Systems engineering for power: status and prospects, Henniker, New Hampshire, August 17—22, 1975.

The present state of technology in power-system security enhancement is reviewed, summarizing past developments, current practices and future trends. Security enhancement is discussed as a logical adjunct to security assessment; it involves on-line decisions aimed at improving (or maintaining) the level of security of a power system in operation. Control strategies are produced by the dispatch computer, but human decision making remains a key element of the control process. The presentation attempts to identify and classify the various available or potential approaches, provide an overview of the associated computational techniques, discuss the major impediments to their implementation, and place the overall problem of security enhancement in perspective. (auth)

6654 (CONF-750867—, pp 196-229) **System control center design.** Dy Liacco, T.E. (Cleveland Electric Illuminating Co., OH). 1975.

From Proceedings on systems engineering for power; Henniker, New Hampshire, USA (17 Aug 1975).

In Systems engineering for power: status and prospects, Henniker, New Hampshire, August 17—22, 1975.

The state-of-the-art of the design of system control centers is reviewed. The structures of control centers and the operating philosophies which affect design are summarized. The extent to which advanced ideas relating to security and control have in fact been implemented are examined. Important design factors, features, and problem areas which should be considered in the implementation of control center projects are discussed. Trends and needs for further development are presented. An up-to-date table is included that provides basic information about modern control centers which are presently in operation and which are in the process of development throughout the world. (auth)

6655 (CONF-750867—, pp 233-257) **Optimal system expansion: a critical review.** Fischl, R. (Drexel Univ., Philadelphia). 1975.

From Proceedings on systems engineering for power; Henniker, New Hampshire, USA (17 Aug 1975).

In Systems engineering for power: status and prospects, Henniker, New Hampshire, August 17—22, 1975.

The state-of-the-art of the long range optimal power system expansion is reviewed. Various formulations of the power system expansion problem in terms of the formal structure of mathematical optimization, such as nonlinear, quadratic, linear, integer and dynamic programming, is evaluated. Some of the recent results in the area of flexible system design under uncertainty, such as worst-case design, statistical design, and tolerance design, are also reviewed and related to the power system planning problem. Attempts are made to point out some areas where more work has to be done. (auth)

6656 (CONF-750867—, pp 261-270) **Economic-environmental system planning for electric power systems.** Ruane, M.; Schweppe, F.; Gruhl, J. (MIT Energy Lab., Cambridge, MA). 1975.

From Proceedings on systems engineering for power; Henniker, New Hampshire, USA (17 Aug 1975).

In Systems engineering for power: status and prospects, Henniker, New Hampshire, August 17--22, 1975.

Economic - Environmental System Planning deals with the incorporation of environmental factors into the long-range system expansion decision process. This survey discusses the basic problems and principles of Economic - Environmental System Planning, including methods for classifying environmental factors and representing such factors in the planning process. The need for economic - environmental sensitivity analysis is considered. The relevant literature is reviewed and areas of needed research are indicated. (auth)

6657 (CONF-750867—, pp 275-288) **Reliability evaluation.** Patton, A.D.; Ayoub, A.K. (Texas A and M Univ., College Station). 1975.

From Proceedings on systems engineering for power; Henniker, New Hampshire, USA (17 Aug 1975).

In Systems engineering for power: status and prospects, Henniker, New Hampshire, August 17—22, 1975.

Indices and methods for evaluating power system reliability performance using probability methods in planning and design studies are reviewed. Particular emphasis is placed on development since about 1960 at which time the utility of a stochastic process view of power systems for the purposes of reliability evaluation was recognized. The present status of reliability evaluation is given and desirable areas of further research are outlined. (auth)

6658 (CONF-750867—, pp 290-308) **Probabilistic methodologies: a critical review.** Reppen, N.D.; Ringlee, R.J.; Wollenberg, B.F.; Wood, A.J.; Clements, K.A. 1975.

From Proceedings on systems engineering for power; Henniker, New Hampshire, USA (17 Aug 1975).

In Systems engineering for power: status and prospects, Henniker, New Hampshire, August 17—22, 1975.

This review is organized about a framework of applications of probability methods to planning, design, and operating tasks in the electric utility industry, the criticism and the opinions to be expressed are organized about the engineering problems in need of solution. Topics included are: failures, outages, and stochastic processes; generation reserve indices, modeling and criteria; probabilistic methodologies in load forecasting; probabilistic methods applied to transmission line design; stochastic power flows; and power flow estimation. (auth)

6659 (CONF-750867—, pp 311-331) **Data bases in power systems operations and planning.** Schlaepfer, F.; Stewart, D.; Jordan, J.A. Jr. (IBM Corp., Palo Alto, CA). 1975.

From Proceedings on systems engineering for power; Henniker, New Hampshire, USA (17 Aug 1975).

In Systems engineering for power: status and prospects, Henniker, New Hampshire, August 17—22, 1975.

A critical survey is presented on data management in power system planning and operations, including problem definition, a review of the state-of-the-art, and identification of major recent achievements and of promising directions for future research and activity. The study deals not only with data bases in a narrow sense, but also addresses the handling and management of general collections of data in power systems planning and operations. The study deals primarily with data bases on a logical level; problems relating to the physical implementation (data mapping, data conversion) are only marginally discussed. Not addressed are questions of data acquisition, telecommunications, nor performance. (auth)

6660 (CONF-750867—, pp 334-352) **Survey of decentralized control methods for large scale systems.** Sandell, N.R. Jr.; Varaiya, P.; Athans, M. (Massachusetts Inst. of Tech., Cambridge). 1975.

From Proceedings on systems engineering for power; Henniker, New Hampshire, USA (17 Aug 1975).

In Systems engineering for power: status and prospects, Henniker, New Hampshire, August 17—22, 1975.

Methods of decentralized control of large scale systems are reviewed, with emphasis on techniques of potential applicability to control of interconnected power systems. (auth)

6661 (CONF-750867—, pp 356-366) **Survey of adaptive stochastic control methods.** Athans, M.; Varaiya, P. (Massachusetts Inst. of Tech., Cambridge). 1975.

From Proceedings on systems engineering for power; Henniker, New Hampshire, USA (17 Aug 1975).

In Systems engineering for power: status and prospects, Henniker, New Hampshire, August 17—22, 1975.

A selected survey is presented of stochastic adaptive control methods, with special emphasis on recent developments based upon stochastic optimization concepts. (auth)

6662 (CONF-750867—, pp 368-392) **Modeling of dynamical processes.** Kwatny, H.G.; Mablekos, V.E. (Drexel Univ., Philadelphia). 1975.

From Proceedings on systems engineering for power; Henniker, New Hampshire, USA (17 Aug 1975).

In Systems engineering for power: status and prospects, Henniker, New Hampshire, August 17—22, 1975.

An attempt is made to catalogue and organize existing information for the purpose of determining the status of theory, methods and practice for building analytical models for engineering use which are specifically applicable to the design, operation and control of electric power systems. (LCL)

6663 (CONF-750867—, pp 394-418) **Equipment and load modeling in power system dynamic simulation.** Undrill, J.M. (Power Technologies, Inc., Schenectady, NY). 1975.

From Proceedings on systems engineering for power; Henniker, New Hampshire, USA (17 Aug 1975).

In Systems engineering for power: status and prospects, Henniker, New Hampshire, August 17—22, 1975.

The development and present status of the equipment modeling used in power system simulation is reviewed, and present needs for development of new or improved modeling methods are examined. (LCL)

6664 (CONF-750867—, pp 421-450) **Stability theory: criteria for transient stability.** Fouad, A.A. (Iowa State Univ., Ames). 1975.

From Proceedings on systems engineering for power; Henniker, New Hampshire, USA (17 Aug 1975).

In Systems engineering for power: status and prospects, Henniker, New Hampshire, August 17—22, 1975.

The use of modern stability theory in the analysis of the dynamic performance of power systems is discussed. The emphasis is upon the stability of the power system when subjected to impacts. (auth)

6665 (CONF-750867—, pp 454-472) **Dynamic and transient stability augmentation.** Meisel, J. (Wayne State Univ., Detroit). 1975.

From Proceedings on systems engineering for power; Henniker, New Hampshire, USA (17 Aug 1975).

In Systems engineering for power: status and prospects, Henniker, New Hampshire, August 17—22, 1975.

Dynamic and transient stability problems being encountered in the operation of bulk-interconnected power systems are discussed based on information supplied in response to questions sent to 132 power specialists in the US, Canada, and Western Europe and on 320 articles on the subject published during 1966 to 1975. Information is included on the classical and modern definitions of steady-state, dynamic, and transient stability; progress in research on bulk-power system stability; system features which lead to dynamic instabilities; the transient stability problem; and recommendations for improving computer simulations; and systems models for studying dynamic stability problems. (LCL)

POWER PLANT COMPONENTS

6666 (CONF-750867—, pp 1-14) **Automatic generation control: performance under normal conditions.** Ewart, D.N. 1975.

From Proceedings on systems engineering for power; Henniker, New Hampshire, USA (17 Aug 1975).

In Systems engineering for power: status and prospects, Henniker, New Hampshire, August 17—22, 1975.

Current practice in Automatic Generation Control (AGC), focusing strictly on the small-signal behavior typical of the quasi-steady state under normal conditions is described, starting with a review of the principles of AGC and hierarchy of control following which some of the functional aspects of AGC are discussed. The viewpoint is from the interconnection rather than from the area. Observations of the behavior of frequency and Area Control Error on actual systems raise questions which are answered in part by analytical work reported. One of the more important results reported is the suggestion that the current practice in frequency bias settings may, in a large interconnection, result in the loss of control of inadvertent interchange and time deviation. (auth)

6667 (CONF-750867—, pp 15-26) **Automatic generation control/normal: load frequency control performance criteria with reference to the use of advanced control theory.** Reddoch, T.W. (Univ. of Tennessee, Knoxville). 1975.

From Proceedings on systems engineering for power; Henniker, New Hampshire, USA (17 Aug 1975).

In Systems engineering for power: status and prospects, Henniker, New Hampshire, August 17—22, 1975.

A critical survey of the literature with respect to the application of advanced control theory to the automatic generation control problem in the normal mode is provided. Information related to the concepts of new control strategies is identified and classified as to its relative merits and application to the AGC process. (auth)

6668 **Sulfur recovery from fluidized bed which heats gas in a closed circuit gas turbine.** Skinner, G.F. (to Foster Wheeler Energy Corp.). US Patent 3,913,315. 21 Oct 1975. Priority date 17 May 1971, United Kingdom of Great Britain and Northern Ireland (UK). 10p.

A power plant is described in which energy is produced by means of a gas turbine driving, for example, an electric generator. The head for the gas turbine is produced by passing the compressed gas through tubes immersed in a fluidized bed burner, the heated gas then driving the turbine. In one preferred form of the invention the fluidized bed burner is fired with a sulfur contaminated fuel such as oil and the bed is constituted by particles, which will react with the sulfur. These sulfur-containing particles are then removed and the sulfur recovered by, for example, burning these particles to give SO_2 gas which can be used in the preparation of sulfuric acid. In this way, pollution of the atmosphere which occurs with conventional power plants fired with sulfur contaminated fuels can be avoided and the sulfur recovered and used. (auth)

ENVIRONMENTAL ASPECTS

6669 (CONF-750867—, pp 87-100) **Economic-environmental operation of electric power systems.** Schweppe, F.; Ruane, M.; Gruhl, J. (MIT Energy Lab., Cambridge, MA). 1975.

From Proceedings on systems engineering for power; Henniker, New Hampshire, USA (17 Aug 1975).

In Systems engineering for power: status and prospects, Henniker, New Hampshire, August 17—22, 1975.

An Economic-Environmental Operating System (EEOS) provides a power system with a way to combine the environment's time varying capability to accept plant emissions with economic considerations and the need to meet demand. This survey paper outlines the basic principles and concepts of EEOS, reviews the available literature, and summarizes the authors' personal opinions on good directions for future research. (auth)

POWER TRANSMISSION AND DISTRIBUTION

SUPERCONDUCTING AND CRYOGENIC SYSTEMS

6670 (BNL—tr—621) **Development of superconducting power transmission lines.** Zhimerin, D.G.; Levitov, V.I.; Blinkov, E.L. 1975. Translation of a Russian report. (CONF-750950—5). 30p. Dep. NTIS $4.00.

From Conference on technical applications of superconductivity; Alushta, USSR (16 Sep 1975).

The construction and testing of a single-phase, 100-meter, 10-kA, 10.5-kV superconducting cable by the end of 1975 or early in 1976 at the USSR Kozhukhovo test site, is described. This facility is equipped with a cryogenic vacuum system, a power supply, and an instrumentation and control center. The superconducting cable consists of eight 12-m straight sections, a single curved section, six connecting sleeves, and two terminal current leads. The cable includes a coaxial current conductor and a cryogenic envelope with a nitrogen-cooled thermal shield. The Nb-Sn superconductor is deposited on the outer and inner walls of the coaxial system of copper tubes 112 and 80 mm in dia and 2 and 3 mm thick. The principal refrigerant, supercritical helium, is used for electrical insulation. Solid dielectric spacers are used for the electrode spacing between the inner and outer conductor. Before choosing the final design of the 100-m test cable, many experimental and theoretical studies were conducted to determine the cable's parameters. (auth)

6671 **Termination for superconducting power transmission systems.** Forsyth, E.B.; Jensen, J.E. (to U.S. Energy Research and Development Administration). US Patent 3,902,000. 26 Aug 1975. Filed date 12 Nov 1974. 16p.

PAT-APPL-523,182.

This patent relates to a cold, electrical gradient, terminal section for a superconducting cable for alternating current power transmission. A cold electrical gradient section filled with a gaseous coolant acting as an insulator is provided in series with a separate thermal gradient section. (auth)

NUCLEAR POWER PLANTS

POWER REACTORS, NON-BREEDING, LIGHT-WATER MODERATED, BOILING WATER COOLED

6672 (ANCR—1259) **Inspection system for Zircaloy clad fuel rods.** Yancey, M.E.; Porter, E.H.; Hansen, H.R. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). Oct 1975. Contract E(10-1)-1375. 49p. Dep. NTIS $4.00.

A description is presented of the design, development, and performance of a remote scanning system for nondestructive examination of fuel rods. Characteristics that are examined include microcracking of fuel rod cladding, fuel-cladding interaction, cladding thickness, fuel rod diameter variation, and fuel rod bowing. Microcracking of both the inner and outer fuel rod surfaces and variations in wall thickness are detected by using a pulsed eddy current technique developed by Argonne National Laboratory (ANL). Fuel rod diameter variation and fuel rod bowing are detected by using two linear variable differential transformers (LVDTs) and a signal conditioning system. The system's mechanical features include variable scanning speeds, a precision indexing system, and a servomechanism to maintain proper probe alignment. Initial results indicate that the system is a very useful mechanism for characterizing irradiated fuel rods. (auth)

6673 (BNWL—1898) **GAPCON-THERMAL-2: a computer program for calculating the thermal behavior of an oxide fuel rod.** Beyer, C.E.; Hann, C.R.; Lanning, D.D.; Panisko, F.E.; Parchen, L.J. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Nov 1975. Contract E(45-1)-1830. 195p. Dep. NTIS $8.50.

A description is presented of the computer code GAPCON THERMAL-2, a light water reactor (LWR) fuel thermal performance prediction code. GAPCON-THERMAL-2, is intended to be used as a calculational tool for reactor fuel steady-state thermal performance and to provide input for accident analyses. Some models used in the code provide best estimate as well as conservative predictions. Each of the individual models in the code is based on the best available data. (auth)

6674 (BNWL-SA—5548) **Role of in-service inspection on the reliability of primary system piping.** Bush, S.H.; Ham, W.C. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1975. Contract E(45-1)-1830. 11p. (CONF-751044—2). Dep. NTIS $4.50.

From ANS topical meeting on nuclear safety; Tucson, Arizona, USA (5 Oct 1975).

The reliability of the primary piping is assessed on the basis of historical data, the role of periodic surface and volumetric inspection in decreasing the probability of a major failure, the validity of the requirements for inspection imposed by ASME Section XI and by NRC Regulatory Guides and the reliability and sensitivity of the various inspection techniques. (auth)

6675 (CONF-750827—, pp 71-82) **Technology for dismantling large radioactive structural components.** Blumberg, R. (Holifield National Lab., Oak Ridge, TN). Sep 1975.

From Conference on decontamination and decommissioning of ERDA facilities; Idaho Falls, Idaho, USA (19 Aug 1975).

In Proceedings of the first conference on decontamination and decommissioning (D and D) of ERDA facilities.

The dismantling of the ERR (Elk River Reactor) was completed successfully and safely in September, 1974. This 58 MW(t), boiling water reactor was removed down to its foundations, and all of the radioactive material was shipped in suitable containers to licensed burial grounds. The most difficult and the unique part of this effort was the cutting up and removal of the radioactive structural parts, namely the inner thermal shield, the pressure vessel, and the outer thermal shield. The tools and techniques for this operation were designed, developed, and fabricated at the Oak Ridge National Laboratory. This development provides the nuclear industry with a viable alternative to entombment and surveillance for decommissioning reactors. The technology used is described, and comments are made on its application to larger, more radioactive systems. (auth)

6676 (CONF-751132—1) **Heavy Section Steel Technology Program. Part I. Program scope, fracture, materials and thermal shock studies.** Whitman, G.D. (Oak Ridge National Lab., Tenn. (USA)). 1975. 36p. Dep. NTIS $5.00.

From Japan Industrial Planning Association symposium; Tokyo, Japan (17 Nov 1975).

A brief summary of the scope of HSST projects is presented. A major emphasis throughout the course of this work is

the verification of methods of fracture prediction which can be utilized in an assessment of pressure vessel integrity. The utility of small specimens which are appropriate for surveillance purposes continues to be investigated in both the unirradiated and post-irradiated conditions. 11 references (auth)

6677 (CONF-751132—2) **Heavy Section Steel Technology Program. Part II. Intermediate vessel testing.** Whitman, G.D. (Oak Ridge National Lab., Tenn. (USA)). 1975. 32p. Dep. NTIS $4.50.

From Japan Industrial Planning Association symposium; Tokyo, Japan (17 Nov 1975).

The testing of the intermediate pressure vessels is a major activity under the Heavy Section Steel Technology Program. A primary objective of these tests is to develop or verify methods of fracture prediction, through the testing of selected structures and materials, in order that a valid basis can be established for evaluating the serviceability and safety of light-water reactor pressure vessels. These vessel tests were planned with sufficiently specific objectives that substantial quantitative weight could be given to the results. Each set of testing conditions was chosen so as to provide specific data by which analytical methods of predicting flaw growth, and in some cases crack arrest, could be evaluated. Every practical effort was made to assure that results would be relevant to some aspect of real reactor pressure vessel performance through careful control of material properties, selection of test temperatures, and design of prepared flaws. 5 references (auth)

6678 (ORNL—5059) **Test of 6-inch-thick pressure vessels. Series 2. Intermediate test vessels V-3, V-4, and V-6.** Bryan, R.H.; Merkle, J.G.; Raftenberg, M.N.; Robinson, G.C.; Smith, J.E. (Oak Ridge National Lab., Tenn. (USA)). Nov 1975. Contract W-7405-eng-26. 275p. Dep. NTIS $7.60.

The second series of intermediate vessel tests were crack initiation fracture tests of 6-in.-thick 39-in.-OD steel vessels with sharp surface flaws approximately $2^1/_2$ in. deep by 8 in. long in the longitudinal weld seams of the test cylinders. Fracture was initiated by means of hydraulic pressurization. One vessel was tested at each of three temperatures: 75, 130, and 190°F. Pretest analyses were made to predict the failure pressures and strains. Fracture toughness data obtained by equivalent-energy analysis of precracked Charpy-V tests and compact-tension specimen tests were used in the fracture analyses. The vessels behaved generally as had been expected. Posttest fracture analyses were also performed for each vessel. Detailed discussions of the fracture analysis methods developed in support of the vessel tests described are included. 34 references. (auth)

6679 (ORNL-TM—5090) **Evaluation of the HSST program intermediate pressure vessel tests in terms of light-water-reactor pressure vessel safety.** Merkle, J.G.; Whitman, G.D.; Bryan, R.H. (Oak Ridge National Lab., Tenn. (USA)). Nov 1975. Contract W-7405-eng-26. 49p. Dep. NTIS $5.45.

Eight 6-in.-thick 39-in.-OD steel pressure vessels containing carefully prepared and sharpened surface cracks have been tested to provide an improved quantitative basis for evaluating the safety margins against fracture of nuclear reactor pressure vessels. The cylindrical regions of the test vessels were fabricated from either A508 class 2 forging steel or A533, grade B, class 1 steel plate. All the eight vessels tested were loaded to failure by internal hydraulic pressure. Flaws in the test vessels ranged from 1.20 to 5.30 in. in depth, and test temperatures ranged from 32 to 196°F. Extensive fast fracture was observed, as expected, at 32°F at a pressure near the gross yield pressure of the test vessel, and two vessels leaked without fracturing at or slightly above 190°F. One of these vessels contained a flawed nozzle, and the other contained a very deep external surface flaw. Another vessel containing a smaller external surface flaw achieved 2 percent strain in the plastic range at 190°F before developing a shear fracture that arrested before reaching the ends of the vessel. Extensive pre- and posttest fracture analyses have been performed for all the intermediate vessels tested. 11 references. (auth)

POWER REACTORS, NON-BREEDING, LIGHT-WATER MODERATED, NON-BOILING WATER COOLED

6680 (BAW—3647-33) **Physics Verification Program. Part III, Tasks 8—11. Summary report.** Baldwin, M.N.; McAdams, V.D.; Warren, H.D.; Webb, H.W. (Babcock and Wilcox Co., Lynchburg, Va. (USA). Research and Development Div.). Oct 1975. Contract AT(11-1)-3109. vp. Dep. NTIS $5.45.

Summary results are presented for the following PWR experimental tasks: fuel gap detectability study, capture measurements, prompt incore detector study, and 17 by 17 subassembly mockups. (DG)

6681 (CONF-751101—17) **Characterization of irradiated fuel rods using pulsed eddy current techniques.** Martin, M.R.; Francis, W.C. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Nov 1975. Contract AT(10-1)-1375. 30p. Dep. NTIS $5.00.

From Joint meeting of the American Nuclear Society and the Atomic Industrial Forum; San Francisco, California, USA (16 Nov 1975).

A number of irradiated fuel rods and unfueled zircaloy cladding tubes ("water tubes") were obtained from the Saxton reactor through arrangements with the Westinghouse Electric Corporation for use in subsequent irradiation effects and fuel behavior programs. A comprehensive nondestructive and corroborative destructive characterization program was undertaken on these fuel rods and tubes by ANC to provide baseline data on their characteristics prior to further testing and for comparison against post-post data. This report deals primarily with one portion of the NDT program performed remotely in the hot cells. The portion of interest in this paper is the pulsed eddy current inspection used in the nondestructive phase of the work. 6 references. (auth)

6682 (CREARE-TN—224) **Effect of elevated pressure on ECC delivery in a simulated PWR geometry. Quarterly progress report, July 1, 1975—September 31, 1975.** Block, J.A.; Crowley, C.J. (Creare, Inc., Hanover, N.H. (USA)). Oct 1975. Contract AT(49-24)-0162. 47p. Dep. NTIS $5.00.

As part of a continuing effort to develop analytical and empirical tools to permit prediction of water delivery to the lower plenum during a postulated LOCA, tests were conducted in a $^1/_{18}$-scale, cylindrical vessel at pressures up to 75 psia. The experiments included tests of countercurrent flow downcomer penetration and of lower plenum voiding, both separately and combined. Countercurrent flow tests, performed at constant pressures of 35, 55 and 75 psia (and in a mode where the plenum pressure varied along a penetration curve), revealed no major surprises at elevated pressure. The dimensionless parameters used previously to correlate the data were found to be still valid. 7 references. (auth)

6683 (DLCS—5000175) **Quarterly operating report. First quarter, 1975.** (Duquesne Light Co., Shippingport, Pa. (USA). Power Stations Dept.). 1975. Contract AT(11-1)-292. 13p. Dep. NTIS $4.50.

During the first quarter of 1975, the Shippingport Atomic Power Station remained shutdown for PWR/LWBR (Pressurized Water Reactor/Light Water Breeder Reactor) Core Conversion. Defueling operations continued throughout the quarter. A nitrogen purge of the upper reactor vessel was initiated on January 3, and then on January 10, the reactor vessel water level was lowered to a level between elevation 706'9" and 707'2". This level has been maintained the remainder of the quarter. The RWD gaseous waste system remained vented to atmosphere throughout the first quarter report period. (auth)

6684 (DLCS—5000275) **Quarterly operating report. Second quarter, 1975.** (Duquesne Light Co., Shippingport, Pa. (USA). Power Stations Dept.). 1975. Contract AT(11-1)-1292. 12p. Dep. NTIS $4.50.

During the second quarter of 1975, the Shippingport Atomic Power Station remained shutdown for PWR/LWBR (Pressurizer Water Reactor/Light Water Breeder Reactor) core conversion. On April 1, the 1C loop primary side was drained and the 1C coolant pump was placed under a nitrogen purge. The BD core removal cooling system remained in service on the 1B loop. Defueling operations continued throughout the quarter. The reactor vessel head was removed on June 16. Since PWR Core 2 operations have been terminated, spare, unirradiated PWR Core 2 seed and blanket assemblies were shipped off-site during this quarter. (auth)

6685 (DLCS—5000474) **Quarterly operating report. Fourth quarter 1974.** (Duquesne Light Co., Shippingport, Pa. (USA)). 1974. Contract AT(11-1)-292. 13p. Dep. NTIS $4.50.

During the fourth quarter of 1974, the Shippingport Atomic Power Station was shutdown for PWR/LWBR (Pressurized Water Reactor/Light Water Breeder Reactor) Core Conversion. On December 26 while performing a cooldown, following a heat-up test, on operational incident occurred during which the cooldown rate exceeded the 10°F/hour allowable limit. A cooldown rate of 13°F to 14°F/hour was experienced for a two hour period. After an evaluation of this incident, it was concluded that no deleterious effects to the primary coolant system occurred. Defueling operations continued during the fourth quarter. (auth)

POWER REACTORS, NON-BREEDING, GRAPHITE MODERATED

6686 (BNWL-SA—5345) **Radiolytic reactions in the coolant of helium cooled reactors.** Tingey, G.L.; Morgan, W.C. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1975. Contract E(45-1)-1830. 12p. (CONF-751007—6). Dep. NTIS $4.50.

From IAEA international meeting on gas-cooled reactors; Julich, F.R. Germany (13 Oct 1975).

The success of helium cooled reactors is dependent upon the ability to prevent significant reaction between the coolant and the other components in the reactor primary circuit. Since the thermal reaction of graphite with oxidizing gases is rapid at temperatures of interest, the thermal reactions are limited primarily by the concentration of impurity gases in the helium coolant. On the other hand, the rates of radiolytic reactions in helium are shown to be independent of reactive gas concentration until that concentration reaches a very low level. Calculated steady-state concentrations of reactive species in the reactor coolant and core burnoff rates are presented for current U. S. designed, helium cooled reactors. Since precise base data are not currently available for radiolytic rates of some reactions and thermal reaction rate data are often variable, the accuracy of the predicted gas composition is being compared with the actual gas compositions measured during startup tests of the Fort Saint Vrain high temperature gas-cooled reactor. The current status of these confirmatory tests is discussed. 12 references. (auth)

6687 (CONF-751101—38) **Development of a recycle fuel for the HTGR.** Homan, F.J.; Long, E.L. Jr.; Beatty, R.L. (Oak Ridge National Lab., Tenn. (USA)). 1975. 5p. Dep. NTIS $4.50.

From Joint meeting of the American Nuclear Society and the Atomic Industrial Forum; San Francisco, California, USA (16 Nov 1975).

A Weak-Acid Resin-derived (WAR) kernel has been selected as the new reference recycle fuel, and the irradiation program reoriented toward establishing optimum specifications. The loaded resin is carbonized to a dispersion of UO_2 in carbon at about 1200°C. Continued heating to higher temperatures can convert the UO_2 to carbide, completely at 1800°C. Performance of WAR fuels at three levels of conversion is compared. 5 references (auth)

6688 (GA-A—13175(Suppl.1)) **Investigation into the cause and consequence of the Fort St. Vrain Pelton wheel incipient fractures. Supplement 1.** (General Atomic Co., San Diego, Calif. (USA)). 14 Nov 1975. Contract E(04-3)-633. vp. Dep. NTIS $4.00.

New Pelton wheels have been successfully machined from forged Inconel 718 billets and installed in the FSV circulators. In comparison with cast Inconel 718, the wrought version offers both higher mechanical properties and improved fatigue fracture resistance. Further evidence is now available supporting the contention that: (1) the fatigue cracking of the cast Pelton wheel buckets was a consequence of their powered operation with water at speeds in excess of 10,000 rpm, and (2) the fatigue cracking of the cast whPelton wheel curvic couplings resulted from operation at the Valmont site with abnormal steam conditions. It is recommended that: (1) the wrought Pelton wheel be accepted for continuous operation at any speed up to 8000 rpm, and (2) the overspeed trip setting be set at 8800 rpm. This will provide adequate operating margin above the 8000 rpm maximum continuous speed. The Pelton wheels will be protected from structural damage if an overspeed condition should occur. (auth)

6689 (GA-A—13486) **Postirradiation examination of capsules HT-24 and HT-25.** Johnson, W.R.; Hamner, R.L.; Robbins, J.M.; Montgomery, B.H. (General Atomic Co., San Diego, Calif. (USA)). 15 Sep 1975. Contract E(04-3)-167. 52p. Dep. NTIS $5.45.

Results are presented of an experiment to compare the irradiation performance of a variety of graphite particles that are candidates for shim particles in Large High-Temperature Gas-Cooled Reactor (LHTGR) fuel manufacture. The shim particles were incorporated into simulated fuel compacts and the compacts were irradiated in the High Flux Isotope Reactor (HFIR) at the Oak Ridge National Laboratory. The shim particles were supplied jointly by GA and ORNL. (auth)

6690 (GA-A—13539) **Reflector dowel strength test, Fort St. Vrain.** Doll, D.W. (General Atomic Co., San Diego, Calif. (USA)). 31 Oct 1975. Contract E(04-3)-633. 20p. Dep. NTIS $4.00.

The strength of the 44.45 mm (1.75 in.) diameter Fort St. Vrain (FSV) reflector dowel for loads directed radially inward toward the center of the element was measured. For a statically applied load, the strength exceeded 5783 N (1300 lb) in direct shear. This strength remained after load cycling 100 times to 4448 N (1000 lb), 10 times to 4893 N (1100 lb), 10 times to 5338 N (1200 lb), and two times to 5783 N (1300 lb). Typically, the deflection to ultimate failure was approximately 1.0 mm (0.04 in.). At about 3316 N (750 lb) and 0.20 mm (0.008 in.) deflection, one of the webs between the dowel and a coolant hole cracked, apparently redistributing the load. No further failure occurred up to the ultimate load of 5783+ N (1300+ lb). (auth)

6691 (GA-A—13602) **Operational testing highlights of Fort St. Vrain.** Cadwell, J.J.; McEachern, D.W.; Read, J.W.; Simon, W.A.; Walker, R.F. (General Atomic Co., San Diego, Calif. (USA)). 29 Sep 1975. Contract E(04-3)-633. 19p. (CONF-751007—7). Dep. NTIS $4.50.

From IAEA international meeting on gas-cooled reactors; Julich, F.R. Germany (13 Oct 1975).

The Fort St. Vrain program has progressed through construction, preoperational testing, fuel loading, initial criticality, and operational testing at power levels up to 2 percent related power. To date, all tests necessary before the rise to full power have been completed, and the rise-to-power program is expected to be resumed again in late 1975. Major plant systems, including the prestressed concrete reactor vessel and circulators, have demonstrated adequate performance. Extensive tests on the reactor core at zero power and up to 2 percent power have demonstrated the accuracy in the design predictions of such core characteristics as critical rod position, control system worths, neutron flux distributions, and temperature coefficients. Gaseous fission product release measurements to date have confirmed the extensive analytical estimates. 6 references (auth)

6692 (GA-A—13603) **Fatigue testing of Fort St. Vrain core outlet thermometer penetration internal attachment welds.** Axline, J.W.; Chiger, H.D.; Ellis, J.R.; Holko, K.H.; Riccardella, P.C. (General Atomic Co., San Diego, Calif. (USA)). 5 Nov 1975. Contract E(04-3)-633. 58p. Dep. NTIS $5.45.

PCRV cooling system heat load and temperature data collected during the Fort St. Vrain Hot Flow Test and rise to 2 percent power revealed that the junction of the core outlet thermometer penetrations and the cavity liner would experience a localized elevated temperature condition at full power operation. A comprehensive structural evaluation of this condition was performed, which included a detailed stress analysis of the steel penetration/liner junction and internal attachment welds. Specimens which simulated critical welds in the vicinity of the core outlet thermometer penetrations were tested under stress levels and conditions far in excess of those anticipated in actual service. The number of cycles to specimen failure or termination of the tests in all cases exceeded the specified plant operating cycles, multiplied by a factor required by the Code, by a large margin. 6 references. (auth)

6693 (GA-A—13606) **High conversion HTGR for resource conservation.** Brogli, R.H.; Hays, M.L.; Lane, R.K.; Turner, R.F. (General Atomic Co., San Diego, Calif. (USA)). 1 Oct 1975. Contract E(04-3)-167. 21p. Dep. NTIS $4.00.

The HTGR offers significant improvements in the utilization of uranium and thorium by increases in the conversion ratio of fissile nuclides. The possible tradeoffs in core design features which result in higher conversion ratios are discussed. The cost effects of fuel cycle tradeoffs affecting resource utilization are presented in graphical form. The standard commercial HTGR design shows a clear capability for achieving a conversion ratio approaching 0.8 without significant changes in core structure. A conversion ratio above 0.8 can be achieved with changes in power density. (auth)

6694 (GA-A—13616) **Structural evaluation of the localized elevated temperatures in the thermometer penetration region of the Fort St. Vrain PCRV.** Gotschall, H.L.; Ople, F.S.; Riccardella, P.C. (General Atomic Co., San Diego, Calif. (USA)). 31 Oct 1975. Contract E(04-3)-633. 57p. Dep. NTIS $5.45.

A structural evaluation was performed to assess the presence of a localized elevated temperature condition in the outlet coolant thermometer penetration region of the Fort St. Vrain PCRV. Thermal analyses, performed in conjunction with the review of data collected during the Hot Flow Test and rise to 2 percent power, show that concrete adjacent to the penetration-liner junction is expected to attain a high temperature of 346°F at full power operation; however, the extent of the elevated temperatures (greater than 250°F) is limited to a small portion of the concrete. The evaluation covered the PCRV, including the steel liners, penetrations, and internal attachments. (auth)

6695 (GA-A—13671) **Component and Systems Development Program. Quarterly progress report for the period ending September 30, 1975.** (General Atomic Co., San Diego, Calif. (USA)). 31 Oct 1975. Contract E(04-3)-167. vp. Dep. NTIS $5.45.

The objectives of the program reported are to provide a data base for the properties of materials used in the noncore construction of important components of the HTGR; to demonstrate the adequacy of the thermal barrier design in two critical areas: (1) fatigue life of attachment fixtures and (2) resiliency of insulation under vibration; and to investigate control and instrumentation systems associated with the safe operation of the HTGR. (auth)

6696 (GA-A—13677) **Test and evaluation of the Fort St. Vrain dew point moisture monitor system.** Block, G.A.; Del Bene, J.V. Jr.; Gitterman, M.; Hastings, G.A.; Hawkins, W.M.; Hinz, R.F.; McCue, D.E.; Swanson, L.L.; Vavrina, J.; Zwetzig, G.B. (General Atomic Co., San Diego, Calif. (USA)). 10 Oct 1975. Contract E(04-3)-633. 103p. Dep. NTIS $5.45.

Descriptions are given of the Fort St. Vrain Dew Point Moisture Monitor (DPMM) System; the bases for the DPMM system response time requirements for safety related functions at the required reactor operating conditions; the results and evaluation of recent testing which measured the performance of the current system at simulated operating conditions; predicted response times for reactor power operation from 0 to 100 percent and a modification to provide improved response times for low-load and plant start-up conditions. (auth)

6697 (GA-A—13692) **Fort St. Vrain surveillance and testing program. Quarterly progress report for the period ending September 30, 1975.** (General Atomic Co., San Diego, Calif. (USA)). 31 Oct 1975. Contract E(04-3)-167. 3p. Dep. NTIS $4.00.

The preparation of the surveillance and testing program for the Fort St. Vrain Reactor is briefly reviewed. (JWR)

6698 (GA-A—13742) **Status report on reserve shutdown system.** (General Atomic Co., San Diego, Calif. (USA)). 25 Nov 1975. Contract E(04-3)-633. 43p. Dep. NTIS $4.00.

During a poison loading conversion of the reserve shutdown system, crystalline deposits were found on the surfaces of several reserve shutdown balls. The reserve shutdown balls consist of B_4C particles intermixed with graphite. The specification for the material allows a small amount (0.15 percent) of B_2O_3 to be present in the balls. The analysis performed on balls taken from a typical hopper indicates that approximately 25 percent of the B_2O_3 has been leached out of the balls and crystallized into harmless boric acid crystals. The performance of the reserve shutdown system has been evaluated and found to be unaffected by the presence of the boric acid crystals. A reserve shutdown system dump test was run which indicated no change in the release capability of the system. An evaluation has been made on the performance of the reactor following a reserve shutdown system dump. The crystals on the balls will either dehydrate and convert back to B_2O_3 or they will vaporize and diffuse into the surrounding graphite and then convert to B_2O_3. Either consequence will not cause any effect on the reactivity which would compromise safety of the reactor core or cause degradation of the primary coolant system components. (auth)

6699 (LA—6157-MS) **Cross section space shielding in double heterogeneous HTGR systems.** Stamatelatos, M.G. (Los Alamos Scientific Lab., N.Mex. (USA)). Nov 1975. Contract W-7405-ENG-36. 12p. Dep. NTIS $4.00.

Collision probability methods using rational approximations for space shielding of cross sections in nuclear reactor codes allowing for one level of heterogeneity are first reviewed. A Dancoff factor for a cylindrical HTGR fuel pin with grain structure is then derived. A new simple method for cross section space shielding in a doubly heterogeneous HTGR system using collision probabilities and rational approximations is subsequently presented and calculations based on it are compared with calculations based on more elaborate methods. 39 references. (auth)

POWER REACTORS, NON-BREEDING, OTHERWISE MODERATED OR UNMODERATED

6700 **An MHD energy storage system comprising a heavy-water producing electrolysis plant and a H_2/O_2/CsOH MHD generator/steam turbine combination to provide a means of transferring nuclear reactor energy from the base-load regime into the intermediate-load and peaking regimes.** Townsend, S.J.; Koziak, W.W. (SJT Consultants Ltd., Thornhill, Ont.). pp 983-989 of In Hydrogen energy. Part B. Veziroglu, T.N. (ed.). New York; Plenum Publishing Corp. (1975).

From Hydrogen economy Miami energy conference; Miami Beach, Florida, USA (18 Mar 1974).

See CONF-740306—PB.

The concept is presented of the MHD Energy Storage System, comprising a heavy-water producing electrolysis plant for electricity absorption, hydrogen/oxygen storage and a high-efficiency MHD generator/steam turbine unit for electricity production on demand from the grid. The overall efficiency at 56 to 60 percent is comparable to pumped storage hydro, but at only one-half to two-thirds the capital cost and at considerably greater freedom of location. The MHD Energy Storage System combined with the CANDU nuclear reactor in Canadian use can supply all-nuclear energy to the grid at a unit energy cost lower than when oil or coal fired plants are used in the same grid. (auth)

POWER REACTORS, BREEDING

6701 (ANL—75-29) **Conceptual design for a 1200-MW(e) Liquid Metal Fast Breeder Reactor (LMFBR) power plant.** Amorosi, A.; Fromm, L.W. (Argonne National Lab., Ill. (USA)). Jun 1975. Contract W-31-109-Eng-38. 32p. AT.

A concept is described which is a synthesis of today's experience with an integrated plant. Some features, although basically sound in principle, remain to be proven. The plant arrangement consists of a cold-leg pump, a three-loop piped system with helium cover gas, and a helium-cooled canned motor drive for the primary pump. It has a low-pressure-drop intermediate heat exchanger (IHX) based on EBR-II experience. The steam generators are contained in a building wrapped around the reactor building. This building also contains auxiliary systems that make access for inspection and repair easier than locating these systems in the area below the floor of the reactor building. The fuel-handling system is a bold but simple system. The operating temperatures of 800°F sodium in and 1100°F out were chosen to indicate the type of research that might be required with a 100°F rise over present temperatures. A number of aspects of the design were chosen to indicate the type of research that might be undertaken to improve performance. (auth)

6702 (ANL-CT—76-06) **Preliminary studies on dynamics of beam/stop impact: numerical analysis.** Shin, Y.S.; Sass, D.E.; Wambsganss, M.W. (Argonne National Lab., Ill. (USA)). Aug 1975. 64p. AT.

6703 (ANL-RDP—43) **Reactor Development Program progress report, September 1975.** (Argonne National Lab., Ill. (USA)). 3 Nov 1975. Contract W-31-109-Eng-38. 160p. AT.

Progress is summarized in the following research and development areas: Experimental Breeder Reactor No. 2, Fuels and Materials Development, Reactor Physics, Reactor Safety, and GCFR design. (auth)

6704 (ANL-RDP—44) **Reactor development program progress report, October 1975.** Sachs, R.G.; Kyger, J.A. (Argonne National Lab., Ill. (USA)). 5 Dec 1975. Contract W-31-109-Eng-38. vp. AT.

Progress is summarized in the following research and development areas: Experimental Breeder Reactor No. 2, Hot Fuel Examination Facility, LMFBR design support, instrumentation and control, fuels and materials development, reactor physics, reactor safety, energy and environmental systems, and other fast breeder reactors. (auth)

6705 (ANL-Trans—1012) **Research on the response of cylindrical shells to hydrodynamic excitations.** Levin, L.; Milan, D.; Payan, G. Translated by Jacqueline Banfield from *Houille Blanche;* **26**: No. 6, 505-512(1971). 22p. Dep. NTIS $4.50.

The Phenix reactor is used to illustrate a method of investigating the response of certain cylindrical structures to the random pressure fluctuations resulting from turbulent fluid flow. The excitations were determined using a hydraulic model, and the vibratory characteristics were determined from the overall behavior of a mechanical model. It is shown how current random shell vibration theory can be used to calculate the response. Formulas giving two upper response limits are easily derived, as the excitation power spectrum density is constant over the shell surface considered, and simple to express mathematically. (FR)

6706 (ANL-Trans—1017) **Construction of the exchangers and steam generators of the fast neutron plant.** Translated from *Tech. Mod.;* **3**: 49-50(Mar 1974). 7p. Dep. NTIS $4.50.

Design specifications, construction methods, and operational performance are briefly summarized. (DG)

6707 (BLG—508) **Results of five years of BR2 reactor utilization. Proceedings of symposium held at Mol, Belgium, 4—5 December 1973.** de Proost, M. (ed.). (Gesellschaft fuer Kernforschung m.b.H., Karlsruhe (F.R. Germany); Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany); Centre d'Etude de

l'Energie Nucleaire, Mol (Belgium)). 1973. 232p. (CONF-731234—).

From Symposium dealing with research and development work on the liquid metal cooled fast breeder reactor, the gas-cooled reactor and the water cooled reactor; Mol, Belgium (4 Dec 1973).

The results of 5 years of joint utilization of the BR-2 reactor and its associated facilities at Mol are reviewed. The 22 papers presented deal with testing of fuel elements and materials for the LMFBR, gas cooled reactors, and water cooled reactors. Separate abstracts were prepared for each of 11 papers. Eleven papers were previously abstracted for NSA as 30: 14502; 14503; 14521; 14540; 14561; 14570; 14571; 14636; 14637; 14638; and 16393.

6708 (CONF-750977—, pp 4.1-4.20) **Reactor core model for a fast breeder power plant simulation.** Saphier, D.; Kirsch, L.W.; Mulcahey, T.P. (Argonne National Lab., IL). 1975.

From 2. power plant dynamics, control and testing symposium; Knoxville, Tennessee, USA (3 Sep 1975).

In Proceedings of the second power plant dynamics, control and testing symposium.

Since a nuclear power plant has a large number of components, even simplified models will give rise to complex simulation programs and in many cases excessive computer time (in the range of hours) is necessary to obtain the required solution. It is therefore of major practical importance to find out what is the optimal simulation method for a particular study. The term "optimal simulation method" is used with respect to computer time—the method that will use the least computer time while maintaining the required accuracy. In the present study, the required accuracy was set to 1 percent—and the optimal method for the reactor neutronics and heat transfer was sought. The present study is part of a CRBR oriented simulation under development at ANL. Although the mathematical models used were by no means new, they were analyzed as to their relative accuracy and the complexity of each module was so chosen as to give the prescribed accuracy for a particular type of transient calculation while keeping the computer time to minimum. The reactor core neutronics and heat transfer simulation were chosen for first consideration in the study because of the wide range of simulation models possible and potential computer time saving resulting from the proper choice of model. (auth)

6709 (CONF-751065—1) **Status of the US program for development of the molten-salt breeder reactor.** McNeese, L.E. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). 1975. 23p. Dep. NTIS $4.50.

From Meeting on molten-salt breeder reactor development; Fontenay-aux-Roses, France (13 Oct 1975).

6710 (CONF-751101—55) **Nuclear characteristics of a 1000-MW(e) molten-salt breeder reactor.** Engel, J.R.; Kerr, H.T.; Allen, E.J. (Oak Ridge National Lab., Tenn. (USA)). Nov 1975. 14p. Dep. NTIS $4.50.

From Joint meeting of the American Nuclear Society and the Atomic Industrial Forum; San Francisco, California, USA (16 Nov 1975).

Included are brief discussions of the MSBR reference concept, core neutronics, core design, breeding and resource utilization, and reactor kinetics. (DG)

6711 (COO—2245-25) **Coolant mixing in LMFBR rod bundles and outlet plenum mixing transients. Progress report, June 1, 1975—August 31, 1975.** Todreas, N.E.; Golay, M.W. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Nuclear Engineering). 1975. Contract AT(11-1)-2245. 38p. Dep. NTIS $4.00.

Information on coolant mixing in LMFBR core regions is presented concerning LMFBR outlet plenum flow mixing, subchannel geometry (bare rods), and bundle geometry (wrapped and bare rods). (DCC)

6712 (COO—2250-15) **MIT LMFBR blanket research project. Quarterly progress report, April 1, 1975—June 30, 1975.** Driscoll, M.J. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Nuclear Engineering). 1975. Contract AT(11-1)-2250. 13p. Dep. NTIS $4.50.

Research progress on physics experiments and calculations for LMFBR breeding blankets is briefly reported. (JWR)

6713 (COO—2250-16) **MIT LMFBR blanket research project. Quarterly progress report, July 1, 1975—September 30, 1975.** Driscoll, M.J. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Nuclear Engineering). 1975. Contract AT(11-1)-2250. 11p. Dep. NTIS $4.50.

Research progress on physics experiments and calculations for LMFBR breeding blankets is briefly reported. (JWR)

6714 (GEAP—13825-14) **Instrumentation development fourteenth quarterly report, April—June 1975.** (General Electric Co., Sunnyvale, Calif. (USA). Breeder Reactor Dept.). Jul 1975. Contract AT(04-3)-893. 32p. AT.

The development of instrumentation for surveillance of the core and in-vessel components of liquid metal fast breeder reactors is described. Current development efforts are focused on high temperature neutron detectors and advanced signal transmission methods. This report covers activity during the period April—June 1975. (auth)

6715 (GEAP—14031-4) **Core restraint engineering. Fourth quarterly report, May—July 1975.** (General Electric Co., Sunnyvale, Calif. (USA). Breeder Reactor Dept.). Aug 1975. Contract AT(04-3)-893. 21p. AT.

LMFBR core restraint system design requirements, subcomponents, and analytical methods are discussed. Progress is described for subtasks related to withdrawal force testing, transient analysis, load pad and channel wall lateral limits, in-reactor load pad surveillance, and withdrawal force minimizer. (auth)

6716 (GEAP—14045-3) **Reliability program for shutdown heat removal. Third quarterly report, June—August 1975.** (General Electric Co., Sunnyvale, Calif. (USA). Fast Breeder Reactor Dept.). Sep 1975. Contract E(04-3)-893. 33p. AT.

Reliability studies of LMFBR shutdown heat removal systems are reported. Activities include completion of a preliminary reliability allocation and apportionment for LMFBR shutdown heat removal systems, and completion of the test plan definition for the shutdown heat removal and structural reliability program. In addition, a probabilistic data report was prepared which provides the failure rate for all failure modes of each component necessary for shutdown heat removal using a probabilistic data sheet for each event. A description of the failure, the basis for the failure rate, and any revision history are given on each sheet. These failure rates were used in the quantitative reliability analysis of LMFBR shutdown heat removal systems. (auth)

6717 (HEDL-SA—766) **Refractory metal carbide coatings for LMFBR applications: a systems approach.** Gotschall, H.L.; Ople, F.S.; Riccardella, P.C. (Union Carbide Corp., Tonawanda, N.Y. (USA). Linde Div.; Westinghouse Hanford Co., Richland, Wash. (USA)). 10 Feb 1975. 28p. (CONF-750234—2). Dep. NTIS $4.00.

From Conference on structure-property relationship in thick film bulk coatings; San Francisco, California, USA (10 Feb 1975).

The selection, testing and improvement of high density, tightly bonded plasma and detonation gun coatings designed to meet LMFBR core component criteria are described. The process descriptions include a review of the important developments in substrate surface preparation which were required to ensure strong bonding and to minimize interface contamination. Coating finishing techniques which were developed to optimize friction behavior are also described. (auth)

6718 (HEDL-SA—795S) **Lifetime predictions for mixed oxide LMFBR fuel pins clad with type 304 stainless steel.** Jackson, R.J.; Saito, G.H.; Cox, C.M. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Jun 1975. 5p. (CONF-750607—38). Dep. NTIS $3.50.

From American Nuclear Society meeting; New Orleans, Louisiana, USA (8 Jun 1975).

A method of predicting fuel pin lifetimes is described for stainless steel clad mixed oxide LMFBR fuel pins at cladding temperatures below about 1100°F. The development of this method required (1) determining empirical relations for in-reactor fuel pin cladding stress and creep rates based on reported strains of EBR-II driver fuel pins, and (2) applying the in-reactor creep equation to mixed oxide fuel pins. Good agreement was obtained between calculated and measured in-reactor creep strain and between an in-reactor strain to failure correlation and observed failures in mixed oxide fuel pins clad with 304 stainless steel. An in-reactor creep relationship for the temperature range 700°F to 1050°F was developed using reported cladding mechanical strain data for the EBR-II metal fueled, driver fuel pins. (auth)

6719 (HEDL-TME—75-1) **HEDL quarterly technical report, January, February, March 1975.** Noordhoff, B.H.; Weber, S.A.; Trego, A.L.; Yatabe, J.M. (Hanford Engineering Development Lab., Richland, Wash. (USA)). May 1975. Contract AT(45-1)-2170. vp. AT.

Progress is reported in the areas of FFTF and LMFBR test program engineering, control and data systems, reactor instrument development, reactor engineering, and nondestructive testing engineering. (DG)

6720 (HEDL-TME—75-71) **LMFBR reference control materials semiannual report.** Burgess, C.A.; Sheely, W.F. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Jul 1975. Contract AT(45-1)-2170. 40p. AT.

Progress on neutron absorber development activities from January, 1975 through June, 1975 is presented. Included are descriptions of activities related to performance analysis, development testing, and fabrication technology. (auth)

6721 (HEDL-TME—75-94) **Inlet plenum feature model flow test of the Clinch River Breeder Reactor: initial results.** McConnell, P.M.; Spalek, J.; Mech, S.F. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Nov 1975. Contract AT(45-1)-2170. vp. AT.

The IPFM models all hydrodynamically important wetted surfaces in a full 360° (0.248 scale) sector of the inlet plenum and lower internal components of the CRBR. Differential pressures, core flow distribution, and turbulent mixing parameters are reported for each of six inlet plenum configurations. The data, obtained from an inlet plenum configuration with a core support structure (CSS) which did not contain the current CSS Auxiliary Flow Port Liner concept, show that the IPFM flow performance is acceptable according to the criteria established by the Designer (ARD). The test results also indicate that the plenum can possibly be shortened by about ten inches without significantly changing the pressure drop, flow distribution, and mixing characteristics. 6 references. (auth)

6722 (LA—6028) **Experience related to the safety of advanced LMFBR fuel elements.** Kerrisk, J.F. (Los Alamos Scientific Lab., N.Mex. (USA)). Jul 1975. Contract W-7405-Eng-36. 29p. Dep. NTIS $4.00.

Experiments and experience relative to the safety of advanced fuel elements for the liquid metal fast breeder reactor are reviewed. The design and operating parameters and some of the unique features of advanced fuel elements are discussed breifly. Transient and steady state overpower operation and loss of sodium bond tests and experience are discussed in detail. Areas where information is lacking are also mentioned. (auth)

6723 (ORNL—5094) **Feasibility studies for nondestructive testing of duplex tube-to-tubesheet joints and tubes for an LMFBR steam generator.** Foster, B.E.; Cook, K.V.; Dodd, C.V.; Simpson, W.A. Jr.; McClung, R.W. (Oak Ridge National Lab., Tenn. (USA)). Dec 1975. Contract W-7405-eng-26. 37p. AT.

Studies were conducted for the development of nondestructive testing techniques for LMFBR steam generators in support of a design concept using duplex tubing. A radiographic technique using ^{192}Ir as the radiation source was developed for the bore-side inspection of duplex tube-to-tubesheet weld joints. Bore-side ultrasonic inspections of the inner member of the duplex tube may be performed at sensitivities comparable with those required for nuclear grade tubing. Simulated flaws at the duplex interface were easily detectable, indicating that longitudinally oriented simulated flaws smaller than 7 percent of the wall of the inner member can be detected with modified commercial transducers. A thermal technique was studied for detection of extremely small variations in the interface gap in the duplex tubing. An eddy-current technique with magnetic saturation, developed with the aid of mathematical models, was investigated for bore-side inspection of duplex tubing. Pit-type defects as small as 25 percent of the duplex wall were detectable. (auth)

6724 (ORNL-TM—5142) **Specification for pseudo-composition-independent fine-group and composition-dependent fine- and broad-group LMFBR neutron-gamma libraries at ORNL.** Weisbin, C.R.; Roussin, R.W.; White, J.E.; Wright, R.Q. (Oak Ridge National Lab., Tenn. (USA)). Dec 1975. Contract W-7405-eng-26. 18p. (ENDF—224). AT.

Specifications are presented for pseudo-composition independent fine-group and broad-group LMFBR neutron-gamma libraries. A one-dimensional cylindrical model of the CRBRP is used to derive the fine- and broad-group composition-dependent data. Energy boundary selection was guided by sensitivity considerations and compatibility with previously existing multigroup sets. Fast reactor data testing of CSEWG benchmark critical assemblies is summarized. (auth)

6725 (ORNL-TM—5173) **Final report of the LMFBR campaign of the experimental engineering section off-gas decontamination facility, March—July 1975.** Klein, J.A.; Gilliam, T.M. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 49p. AT.

Results of a four-month campaign for studying the removal of krypton from simulated Liquid Metal Fast Breeder Reactor reprocessing off-gas are presented. The experiments were performed in the Experimental Engineering Section Off-Gas Decontamination Facility with a refrigerant 12-N_2-Kr system. The experiments performed indicate values of HTU for krypton into liquid fluorocarbon on the order of 0.33 ft. These engineering scale experiments achieved decontamination factors of from 5 to 10,000 with gas flows up to 3.6 scfm with a nominal liquid flow of 0.3 gpm. 8 references. (auth)

6726 (SAND—75-0556) **Pressure predictions for reactor fuel pin assemblies with the ANEOS equation of state.** Burchett, O.L.; Beisinger, Z. (Sandia Labs., Albuquerque, N.Mex. (USA)). Nov 1975. Contract AT(29-1)-789. 15p. Dep. NTIS $4.00.

ANEOS, the CHART D analytical equation of state was used to calculate the equilibrium pressure in a reactor fuel pin assembly that is produced by a neutron pulse. Details of the calculational procedure and the pressures that were calculated for the PBE experiment are presented. (auth)

6727 (WARD-CR—3045-9) **Core restraint development. Quarterly progress report for period ending 31 May 1975.** (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). Dec 1975. Contract E(11-1)-3045. 20p. AT.

The initial test plan for 121-assembly testing has been completed. Plans are being made to study effects of "on power" and straight assembly cores on the 121-assembly configuration. The modeling techniques used by ANL in PARABOW may be incorporated in codes used by ARD. Withdrawal force tests on single assemblies being carried out at HEDL are 90 percent complete. Plans are being made to run frictional tests on ARD test components at HEDL. (auth)

6728 (WARD-HT—3045-11) **Validation of high temperature design methods and criteria. Quarterly progress report for period ending February 28, 1975.** (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). Aug 1975. Contract E(11-1)-3045. 144p. AT.

Progress is reported in the testing and analysis of Type 304 and 306 stainless steel plate and tubular specimens for FFTF and LMFBR pressure-containing components. Included are data on core design methods, basic specimen testing, tubular specimen testing, structure testing, FFTF intermediate heat exchanger inlet nozzle testing, analysis methods and procedures, elevated temperature design standard, and crack propagation testing. (DG)

6729 (WARD-HT—3045-12) **Validation of high temperature design methods and criteria. Quarterly progress report for period ending May 31, 1975.** (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). 1975. Contract E(11-1)-3045. 126p. AT.

Progress is reported in the testing and analysis of Types 304 and 316 stainless steel plates and tubular specimens of FFTF and LMFBR components. Data are included on core design methods, basic specimen testing, tubular specimen testing, structure testing, FFTF intermediate heat exchanger nozzle testing, analytical methods and procedures, and crack propagation testing. (JWR)

6730 (WARD-RB—3045-10) **Radial blanket design and development. Quarterly progress report for period ending May 31, 1975.** Bishop, E.C. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). Oct 1975. Contract E(11-1)-3045. 92p. AT.

A summary of prior work and current progress is presented in the areas of radial blanket assembly heat transfer testing, radial blanket fuel, and assembly irradiation testing, radial blanket flow orificing tests, and radial blanket rod bundle compaction tests. (DG)

6731 (ANL-Trans—1020) **Hydraulic problems occurring in sodium cooled fast reactor.** Duport, J.P.; Abecassis, G.; Chenal, J.C.; Constantin, J.P.; Daubert, A.; Gama, J.M.; Lambert, P.; Leon, P.; Morin, B. Translated from *Bull. Inf. A.T.E.N.* (*Assoc. Tech. Energ. Nucl.*); No. 83, 46-57(1970). 32p. (CONF-700307—9). Dep. NTIS $5.00.

From Symposium on progress in sodium-cooled fast reactor engineering; Monaco, France (23 Mar 1970).

Isothermal hydraulics, thermohydraulics, fluctuating hydrodynamic forces, transitory hydraulics, and cavitation in LMFBR type reactors are discussed. Some experience concerning these phenomena in Phenix and Rapsodie is described. (JWR)

6732 (ANL-Trans—1016) **Fluctuating hydrodynamic forces in the tanks of the Phenix reactor.** Lambert, P.; Leon, P. Translated by Julie Hamlin from *Houille Blanche;* **26**: No. 6, 499-503(1971). 11p. (CONF-710347—1). Dep. NTIS $4.50.

From Meeting on some problems of hydro-and aeroelasticity; Paris, France (18 Mar 1971).

The pressure fluctuations measured on the reduced model of the Phenix reactor tanks are of uncertain characteristics in the domain of lower frequencies. The total level of fluctuations varies

very little in different locations on the reactor tank wall, within the particular safe zone. By replacing the Froude number similarity by a real velocity similarity, double the average velocity, the pressure fluctuations are augmented in the ratio of average velocities rather than in the ratio of square of velocities. The spectrum analysis of energy density confirmed the previous conclusions; the direct spectrums are continuous spectrums and decrease in the lower frequency bands spreading very little beyond 10Hz. One is able to compare the spectrums of homogeneous turbulence and isotropic turbulence. Finally, the determination on the reduced model of fluctuating hydrodynamic forces by measuring pressure pulses a certain number of precautions in the building of the model and the concept of its supply, for preventing parasitic pressure fluctuations which render analysis of the results very delicate. (auth)

6733 (ANL-Trans—1015) **Phenix power plant work on the site.** Labat, M.P.; Gregut, A. Translated by Julie Hamlin from *Energ. Nucl. (Paris)*; **13**: No. 3, 213-217(1971). 12p. Dep. NTIS $4.50.

The site preparation and excavation, foundation work, and plant construction and assembly at the Phenix Reactor are described. (JWR)

6734 (ANL-Trans—1018) **Vibratory state of the fuel tins and assemblies of the Phenix reactor.** Ginier, R.; Pontier, M. Translated by Jacqueline Banfield from *Houille Blanche;* **26**: No. 6, 513-517(1971). 14p. Dep. NTIS $4.50.

The vibrations of fuel elements immersed in Na flowing quasi-parallel to the fuel assemblies were studied as part of a program on the hydraulics associated with reactor technology. The studies were undertaken in view of ensuring that for the different element-supporting arrangements and spacings, fatigue stresses affecting the safety of the reactor will not occur. Full size models of the assembly with simulated Na flow and very similar hydraulic and mechanical considerations were used. It was verified that under normal working conditions no dangerous vibrations of the fuel elements or assembly could occur. (FR)

6735 (ANL-Trans—1014) **Simulator of the Phenix power plant.** Fourcade, C. Translated by J. Hamlin from *Bull. Instrum. Nucl.;* No. 43, 37-38(Mar 1971). 4p. Dep. NTIS $4.50.

This simulator, installed at Cadarache, is intended to familiarize operators with the dynamic behavior and the startup and shutdown procedures of the plant. The requirements sought were maximum simplicity, reliability and a capability of simulating the low transients of the power plant. This simulator consists of an E.A.I. 8945 hybrid unit and a control desk for monitoring the control rods of the primary and secondary coolant loops, the emergency shutdowns,and the water flow rate in the vapor generator. (FR)

6736 (EURFNR—1246) **Design, irradiation, and post-irradiation examination of UO_2/PuO_2 fuel pins irradiated in experiment Mol 8B.** Weimar, P.; Sebening, H. (Kernforschungszentrum Karlsruhe (F.R. Germany)). Jan 1975. Translation of KFK—2106. 116p. Dep. NTIS $6.50.

Work performed under United States—Euratom Fast Reactor Exchange Program.

Included are data on the fuel pin design, specifications, and fabrication as well as a detailed description of irradiation and post irradiation examination results. (auth)

6737 **Radial blanket assembly orificing arrangement.** Patterson, J.F. (to U.S. Energy Research and Development Administration). US Patent 3,892,625. 1 Jul 1975. Filed date 12 Oct 1973. 8p.

PAT-APPL-406,519.

A nuclear reactor core for a liquid metal cooled fast breeder reactor is described in which means are provided for increasing the coolant flow through the reactor fuel assemblies as the reactor ages by varying the coolant flow rate with the changing coolant requirements during the core operating lifetime. (auth)

6738 **Liquid level controller.** Mangus, J.D.; Redding, A.H. (to U.S. Energy Research and Development Administration). US Patent 3,894,554. 15 Jul 1975. Filed date 10 May 1972. 8p.

PAT-APPL-251,992.

A system for maintaining two distinct sodium levels within the shell of a heat exchanger having a plurality of J-shaped modular tube bundles each enclosed in a separate shell which extends from a common base portion. A lower liquid level is maintained in the base portion and an upper liquid level is maintained in the shell enwrapping the long stem of the J-shaped tube bundles by utilizing standpipes with a notch at the lower end which decreases in open area the distance from the end of the stand pipe increases and a supply of inert gas fed at a constant rate to produce liquid levels, which will remain generally constant as the flow of liquid through the vessel varies. (auth)

6739 **Measurement of the differential pressure of liquid metals.** Metz, H.J. (to U.S. Energy Research and Development Administration). US Patent 3,902,369. 2 Sep 1975. Filed date 2 May 1974. 4p.

PAT-APPL-466,347.

This patent relates to an improved means for measuring the differential pressure between any two points in a process liquid metal coolant loop, wherein the flow of liquid metal in a pipe is opposed by a permanent magnet liquid metal pump until there is almost zero flow shown by a magnetic type flowmeter. The pressure producing the liquid metal flow is inferred from the rate of rotation of the permanent magnet pump. In an alternate embodiment, a differential pressure transducer is coupled to a process pipeline by means of high-temperature bellows or diaphragm seals, and a permanent magnet liquid metal pump in the high-pressure transmission line to the pressure transducer can be utilized either for calibration of the transducer or for determining the process differential pressure as a function of the magnet pump speed. (auth)

6740 **Liquid-level sensing device.** Goldfuss, G.T. (to U.S. Energy Research and Development Administration). US Patent 3,905,243. 16 Sep 1975. Filed date 11 Sep 1973. 10p.

PAT-APPL-396,339.

This invention relates to a device for sensing the level of a liquid while preventing the deposition and accumulation of materials on the exterior surfaces thereof. Two dissimilar metal wires are enclosed within an electrical insulating material, the wires being joined together at one end to form a thermocouple junction outside the insulating material. Heating means is disposed within the electrical insulating material and maintains the device at a temperature substantially greater than that of the environment surrounding the device, the heating means being electrically insulated from the two dissimilar thermocouple wires. In addition, a metal sheath surrounds and contacts both the electrical insulating material and the thermocouple junction. Electrical connections are provided for connecting the heating means with a power source and for connecting the thermocouple wires with a device for sensing the electrical potential across the thermocouple junction. (auth)

REGULATION AND LICENSING

6741 (CONF-750827—, pp 31-45) **Decommissioning and decontamination of licensed reactor facilities and demonstration nuclear power plants.** Lear, G.; Erickson, P.B. (Nuclear Regulatory Commission, Washington, DC). Sep 1975.

From Conference on decontamination and decommissioning of ERDA facilities; Idaho Falls, Idaho, USA (19 Aug 1975).

In Proceedings of the first conference on decontamination and decommissioning (D and D) of ERDA facilities.

Decommissioning of licensed reactors and demonstration nuclear power plants has been accomplished by mothballing (protective storage), entombment, and dismantling or a combination of these three. The alternative selected by a licensee seems to be primarily based on cost. A licensee must, however, show that the decommissioning process provides adequate protection of the health and safety of the public and no adverse impact on the environment. To date the NRC has approved each of the alternatives in the decommissioning of different facilities. The decommissioning of small research reactors has been accomplished primarily by dismantling. Licensed nuclear power plants, however, have been decommissioned primarily by being placed in a mothballed state in which they continue to retain a reactor license and the associated licensee responsibilities. (auth)

6742 (FIND—50338-R1) **FIND: North Anna Power Station, Units 1 and 2.** Williams, W.H. (ed.). (Nuclear Regulatory Commission, Washington, D.C. (USA)). Dec 1975. 24p. Dep. NTIS $4.00.

An index is presented for the docket report material submitted in conjunction with the application for a nuclear power plant construction permit and operating license. The index citations are to the beginnings of major headings, sections, responses, etc., and refer to grid coordinates on microfiche sheets prepared for each docket report. (DG)

6743 (FIND—50448-R1) **FIND: Douglas Point Nuclear Generating Station, Units 1 and 2.** Moore, M.M. (ed.). (Energy Research and Development Administration, Oak Ridge, Tenn. (USA). Technical Information Center). Dec 1975. 25p. Dep. NTIS $4.00.

This index is presented as a guide to microfiche items 1 through 136 in Docket 50448, which was assigned to Potomac Electric Power Company's Application for Licenses to construct and operate Douglas Point Nuclear Generating Station, Units 1 and 2. Information received from August, 1973 through July, 1975 is included. (auth)

ECONOMICS

6744 (BNWL-SA—5525) **Nuclear option.** Schmid, L.C. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1975. Contract E(45-1)-1830. 15p. (CONF-750746—1). Dep. NTIS $4.50.

From Bend in the river conference; Bend, Oregon, USA (5 Jul 1975).

The comparison of coal, oil, and nuclear energy as sources of electric power for the U. S. is presented. Economic and safety aspects are considered. (DCC)

FUEL CYCLE

6745 (BNWL-B—437) **Status report: conceptual fuel cycle studies for the Hanford Nuclear Energy Center.** Merrill, E.T.; Fleischman, R.M. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jul 1975. Contract AT(45-1)-1830. 43p. Dep. NTIS $4.00.

A summary is presented of the current status of studies to determine the logistics of onsite plutonium recycle and the timing involved in introducing the associated reprocessing and fabrication fuel cycle facilities at the Hanford Nuclear Energy Center. (auth)

PROCESS HEAT REACTORS

6746 (LA—6113-MS) **Predicted nuclear heating and temperatures in gas-cooled nuclear reactors for process heat applications.** Cort, G.E.; Vigil, J.C.; Jiacoletti, R.J. (Los Alamos Scientific Lab., N.Mex. (USA)). Sep 1975. Contract W-7405-ENG-36. 27p. Dep. NTIS $4.00.

The high-temperature gas-cooled nuclear reactor (HTGR) is an attractive potential source of primary energy for many industrial and chemical process applications. Significant modification of current HTGR core design will be required to achieve the required elevations in exit gas temperatures without exceeding the maximum allowable temperature limits for the fuel material. A preliminary evaluation of the effects of various proposed design modifications by predicting the resulting fuel and gas temperatures with computer calculational modeling techniques is reported. The design modifications evaluated are generally those proposed by the General Atomic Company (GAC), a manufacturer of HTGRs, and some developed at the LASL. The GAC modifications do result in predicted fuel and exit gas temperatures which meet the proposed design objectives. (auth)

6747 (ORNL-TM—5070(Rev.)) **Impact of increased fuel costs and inflation on the cost of desalting sea water and brackish waters.** Reed, S.A. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 22p. Dep. NTIS $5.00.

The combined increases in the cost of fuel, equipment, and money during the past four years have had a marked impact on the cost of desalting saline waters. The current costs of desalting seawater by distillation and reverse osmosis and brackish waters by reverse osmosis and electrodialysis as a function of plant size and feedwater chemistry are estimated. Typically, distillation plant capital costs have increased from $1 per daily gallon to $3 per daily gallon for large plants (100 Mgd) and from approximately $1.40 per daily gallon to approximately $5 per daily gallon per plant sizes of 5 Mgd or less. Consequently, water costs are now ranging from $3 to $4 per 1000 gal when oil is used to generate steam. Similarly, the costs of desalting inland brackish waters using reverse osmosis or electrodialysis have increased significantly. (auth)

NUCLEAR REACTOR TECHNOLOGY

THEORY AND CALCULATION

6748 (CONF-750607—29) **Relationship of observed flow patterns to gas core reactor criticality.** Macbeth, P.J.; Kunze, J.F.; Rogers, V.C. (Idaho National Engineering Lab., Idaho Falls (USA); Brigham Young Univ., Provo, Utah (USA)). 1975. 4p. Dep. NTIS $4.00.

From American Nuclear Society meeting; New Orleans, Louisiana, USA (8 Jun 1975).

The gas core reactor requires the establishment of stable and unique flow patterns. A recent series of room temperature flow tests have studied the hydrodynamics, particularly involving gases of differing densities. In an actual operating gas core reactor, the central gas of vaporized uranium will have a much higher density than the surrounding coolant. Testing was done in two different sized chambers (18 inch and 36 inch diameter) to study hydrodynamic scaling. Air was employed as the "coolant" gas. Air, argon, and freon, smoked for identification, was used to simulate the fuel. A variety of injectors at various locations in the cavity were employed. (auth)

6749 (CONF-750977—, pp 21.1-21.28) **Diagnostics of void fluctuations in a reactor coolant channel using neutron noise techniques.** Lu, J.T.; Danofsky, R.A.; Struss, R. (Iowa State Univ., Ames). 1975.

From 2. power plant dynamics, control and testing symposium; Knoxville, Tennessee, USA (3 Sep 1975).

In Proceedings of the second power plant dynamics, control and testing symposium.

An experimental investigation has been initiated to study the characteristics of the local neutron detector response perturbations due to the stochastic nature of coolant void formation and motion in a water channel. Measurements of the neutron transmission through a water channel containing air and steam bubbles have been performed. Auto-power spectral densities and probability density functions of the detected stochastic component of the transmitted neutron beam have been found to be very sensitive to the characteristics of the bubble generation and motion. (auth)

6750 (CONF-751116—8) **Multivariate statistical pattern recognition system for reactor noise analysis.** Gonzalez, R.C.; Howington, L.C.; Sides, W.H. Jr.; Kryter, R.C. (Oak Ridge National Lab., Tenn. (USA)). 1975. 9p. Dep. NTIS $4.50.

From Nuclear science symposium; San Francisco, California, USA (17 Nov 1975).

A multivariate statistical pattern recognition system for reactor noise analysis was developed. The basis of the system is a transformation for decoupling correlated variables and algorithms for inferring probability density functions. The system is adaptable to a variety of statistical properties of the data, and it has learning, tracking, and updating capabilities. System design emphasizes control of the false-alarm rate. The ability of the system to learn normal patterns of reactor behavior and to recognize deviations from these patterns was evaluated by experiments at the ORNL High-Flux Isotope Reactor (HFIR). Power perturbations of less than 0.1 percent of the mean value in selected frequency ranges were detected by the system. 19 references. (auth)

6751 (COO—2262-7) **Finite element method for neutron diffusion problems in hexagonal geometry.** Wei, T.Y.C.; Hansen, K.F. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Nuclear Engineering). Jun 1975. Contract AT(11-1)-2262. 311p. Dep. NTIS $9.75.

Thesis.

The use of the finite element method for solving two-dimensional static neutron diffusion problems in hexagonal reactor configurations is considered. It is investigated as a possible alternative to the low-order finite difference method. Various piecewise polynomial spaces are examined for their use in hexagonal problems. The central questions which arise in the design of these spaces are the degree of incompleteness permissible and the advantages of using a low-order space fine-mesh approach over that of a high-order space coarse-mesh one. There is also the question of the degree of smoothness required. Two schemes for the construction of spaces are described and a number of specific spaces, constructed with the questions outlined above in mind, are presented. They range from a complete non-Lagrangian, non-Hermite quadratic space to an incomplete ninth order space. Results are presented for two-dimensional problems typical of a small high temperature gas-cooled reactor. From the results it is concluded that the space used should at least include the complete linear one. Complete spaces are to be preferred to totally incomplete ones. Once function continuity is imposed any additional degree of smoothness is of secondary importance. For flux shapes typical of the small high temperature gas-cooled reactor the linear space fine-mesh alternative is to be preferred to the perturbation quadratic space coarse-mesh one and the low-order finite difference method is to be preferred over both finite element schemes. (auth)

6752 (DP-MS—75-74) **Acceleration techniques for response matrix methods.** Sicilian, J.M.; Pryor, R.J. (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Lab.). 1975. Contract AT(07-2)-1. 22p. (CONF-751101—40). Dep. NTIS $4.50.

From Joint meeting of the American Nuclear Society and the Atomic Industrial Forum; San Francisco, California, USA (16 Nov 1975).

Application of the power iteration method to the multigroup response matrix equations reduces them to a series of one-group

problems. Applying acceleration techniques to each of these monoenergetic problems results in substantial reductions in computational effort. The use of point over-relaxation methods in the solution of these equations is described. Over-relaxation is also applied to the outer-iteration eigenvalue and source estimations with considerable success. 10 references. (auth)

6753 **Determination of parameters of a nuclear reactor through noise measurements.** Cohn, C.E. (to U.S. Energy Research and Development Administration). US Patent 3,894,912. 15 Jul 1975. Filed date 21 Dec 1973. 6p.
PAT-APPL-427,394.

A method of measuring parameters of a nuclear reactor by noise measurements is described. Noise signals are developed by the detectors placed in the reactor core. The polarity coincidence between the noise signals is used to develop quantities from which various parameters of the reactor can be calculated. (auth)

COMPONENTS AND ACCESSORIES

6754 (BNL—20734) **Evaluation of burst probability for tubes by Weibull distributions.** Kao, S. (Brookhaven National Lab., Upton, N.Y. (USA)). Oct 1975. Contract E(30-1)-16. 15p. Dep. NTIS $3.50.

The investigations of candidate distributions that best describe the burst pressure failure probability characteristics of nuclear power steam generator tubes has been continued. To date it has been found that the Weibull distribution provides an acceptable fit for the available data from both the statistical and physical viewpoints. The reasons for the acceptability of the Weibull distribution are stated together with the results of tests for the suitability of fit. In exploring the acceptability of the Weibull distribution for the fitting, a graphical method to be called the "density-gram" is employed instead of the usual histogram. With this method a more sensible graphical observation on the empirical density may be made for cases where the available data is very limited. Based on these methods estimates of failure pressure are made for the left-tail probabilities.

FUEL ELEMENTS

6755 (BNWL—1897) **User's guide for GAPCON-THERMAL-2: a computer program for calculating the thermal behavior of an oxide fuel rod.** Beyer, C.E.; Hann, C.R.; Lanning, D.D.; Panisko, F.E.; Parchen, L.J. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Nov 1975. Contract E(45-1)-1830. 112p. Dep. NTIS $5.50.

This report is being published as a user's manual for GAPCON-THERMAL-2 and provides a general description of the code and instructions for its use. The GAPCON-THERMAL-2 code was developed for the Regulatory Staff, NRC, to use as a tool in estimating fuel-cladding gap conductances and fuel stored energy and represents a modification of the GAPCON-THERMAL-1 code. The goal of the modifications was to reduce uncertainties associated with calculating power history and burnup effects and yet retain a relatively flexible and fast running code for parametric studies. 15 references (auth)

6756 (CONF-751101—14) **Error analyses on three methods for experimentally obtaining gap conductance values.** Tolman, E.L.; Wells, M.E. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). 1975. Contract AT(10-1)-1375. 4p. Dep. NTIS $4.50.

From Joint meeting of the American Nuclear Society and the Atomic Industrial Forum; San Francisco, California, USA (16 Nov 1975).

Gap conductance is a significant factor affecting the stored energy in a fuel rod at the beginning of a hypothetical accident sequence, as well as the thermal and mechanical response of the fuel rod during the accident. Additional well-characterized experimental results are needed to evaluate and improve the current analytical models used to calculate gap conductance during steady-state and transient reactor conditions. The basic difficulty in obtaining the needed data is the inherent uncertainty existing in any experimental method used to determine gap conductance information. The results of error analyses made on three experimental methods are presented and their relative uncertainties analyzed. (auth)

6757 **Tubular electric heater with a thermocouple assembly.** House, R.K.; Williams, D.E. (to U.S. Atomic Energy Commission). US Patent 3,898,431. 5 Aug 1975. Filed date 29 Jan 1974. 6p.
PAT-APPL-438,149.

This patent relates to a thermocouple or other instrumentation which is installed within the walls of a tubular sheath surrounding a process device such as an electric heater. The sheath comprises two concentric tubes, one or both of which have a longitudinal, concave crease facing the other tube. The thermocouple is fixedly positioned within the crease and the outer tube is mechanically reduced to form an interference fit onto the inner tube. (auth)

CONTROL SYSTEMS

6758 (ANL-CT—74-19) **Development of self-actuated shutdown systems for LMFBR plants. Final report.** (Argonne National Lab., Ill. (USA)). Jul 1974. 101p. AT.

6759 (ANL-CT—76-16) **Flow induced vibrations of the HCM/FTR control rod drive mechanism.** Turula, P. (Argonne National Lab., Ill. (USA)). Sep 1975. 33p. AT.

Available information relating to the vibration analysis of the FFTF control rod drive mechanism (CRDM) is presented. The basic vibration computations presented were carried out using the NASTRAN program and include a modal analysis and a frequency response determination. 8 references. (auth)

6760 (CONF-750977—) **Proceedings of the second power plant dynamics, control and testing symposium, Knoxville, Tennessee, September 3—5, 1975.** Kerlin, T.W. (ed.). (Tennessee Univ., Knoxville (USA). Dept. of Nuclear Engineering). 1975. vp. Univ. of Tennessee, Knoxville.

From 2. power plant dynamics, control and testing symposium; Knoxville, Tennessee, USA (3 Sep 1975).

Included are 22 papers on fossil fueled and nuclear power plant modeling, simulation, control, performance evaluation by dynamic testing, and incipient failure detection. A separate abstract was prepared for each paper for inclusion in NSA and/or ERA. (HDR)

6761 (CONF-750977—, pp 15.1-15.33) **On-line reactor surveillance algorithm based on multivariate analysis of noise.** Piety, K.R.; Robinson, J.C. (Univ. of Tennessee, Knoxville). 1975.

From 2. power plant dynamics, control and testing symposium; Knoxville, Tennessee, USA (3 Sep 1975).

In Proceedings of the second power plant dynamics, control and testing symposium.

The development and demonstration of a computer-oriented approach for on-line reactor surveillance are described. A characterization of the reactor state is developed from the analysis of noise signals, and the surveillance algorithm forms a statistical description of normal behavior from this characterization. Hyperellipsoids constructed from this description are used to enclose normal regions of behavior in the multi-dimensional measurements space which represents all possible reactor states. When measurements falling outside of normal regions are detected, the status of the reactor is suspect. This algorithm has been implemented on a minicomputer and has demonstrated its effectiveness in on-line tests. An experiment at the High Flux Isotope Reactor demonstrated the ability of the algorithm to sense changes in reactor conditions that the plant instrumentation could not detect. (auth)

6762 (CONF-751101—36) **On-line reactor surveillance algorithm based on multivariate analysis of noise.** Piety, K.R.; Robinson, J.C. (Tennessee Univ., Knoxville (USA)). 1975. 6p. Dep. NTIS $4.00.

From Joint meeting of the American Nuclear Society and the Atomic Industrial Forum; San Francisco, California, USA (16 Nov 1975).

A mini-computer based surveillance algorithm for monitoring signals from nuclear power plants to provide advanced warning of anomalous conditions has been developed and implemented for on-line applications. The reactor state is characterized by the analysis of noise signals. During an observation period when normal conditions prevail, the surveillance algorithm utilizes these noise characterizations to form a statistical description of normal reactor behavior. At the conclusion of this observation period, the surveillance algorithm examines each new incoming characterization to determine if it differs signicantly from the normal description. (auth)

6763 (HEDL-SA—956) **SCRAM: a program for calculating scram times.** Bourquin, R.D.; Birney, K.R. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 15 May 1975. 18p. (CONF-751101—65). Dep. NTIS $4.50.

From Joint meeting of the American Nuclear Society and the Atomic Industrial Forum; San Francisco, California, USA (16 Nov 1975).

Prediction of scram times is one facet of design analysis for control rod assemblies. Parameters for the entire control rod subsystem must be considered in such analyses and experimental verification is used when it is available. The SCRAM computer program was developed for design analysis of improved control rod assemblies for the Fast Flux Test Facility (FFTF). A description of the evolution of the program from basic equations to a functional design analysis tool is presented. (auth)

6764 **Quick release latch for reactor scram.** Johnson, M.L.; Shawver, B.M. (to U.S. Energy Research and Development Administration). US Patent 3,905,634. 16 Sep 1975. Filed date 4 Jun 1974. 8p.

PAT-APPL-476,184.

A simple, reliable, and fast-acting means for releasing a control element and allowing it to be inserted rapidly into the core region of a nuclear reactor for scram purposes is described. A latch mechanism grips a coupling head on a nuclear control element to connect the control element to the control drive assembly. The latch mechanism is closed by tensioning a cable or rod with an actuator. The control element is released by de-energizing the actuator, providing fail-safe, rapid release of the control element to effect reactor shutdown. A sensing rod provides indication that the control element is properly positioned in the latch. Two embodiments are illustrated, one involving a collet-type latch mechanism, the other a pliers-type latch mechanism with the actuator located inside the reactor vessel. (auth)

ENVIRONMENTAL ASPECTS

6765 (ERDA—69) **Environmental impact of electrical power generation: nuclear and fossil.** (Pennsylvania Dept. of Education, Harrisburg (USA)). 1975. Contract AT(40-2)-4167. 240p. Dep. NTIS $8.00.

The increasing need for electrical power, and current and proposed methods for meeting this need are examined. Expansion of electrical generating capacity in the immediate future will be limited to nuclear power plants or fossil-fueled plants. Basic ecology and wastes from nuclear and fossil-fueled plants are discussed. Health effects are analyzed. The factors that must be taken into consideration when choosing the site for a new power plant are presented. Energy conservation and a summary of environmental effects are included. (auth)

6766 (RLO—1388-296) **Energy controversy: the role of nuclear power.** Schmidt, F.H.; Bodansky, D. (Washington Univ., Seattle (USA). Dept. of Physics). Feb 1975. 101p. Dep. NTIS $6.50.

The objective of the paper presented is to show that nuclear fission power is the best, and maybe the only, alternative source of energy. It is written for a wide range of readers, including nonscientists and scientists who are not particularly informed on the issues involved. The first question considered concerns man's need for energy; it is concluded that conservation measures alone cannot suffice. Next, the earth's energy sources are examined, and the extent of each is estimated in the simple context of the length of time it could last at present use rates. Only nuclear fission, nuclear fusion, and solar energy can provide for future time scales commensurate with man's historic past, while avoiding the possibility of catastrophic social upheaval. Fusion and solar energy are rejected on technological grounds because the world energy problem is so pressing that one cannot gamble on hopes for future technological breakthroughs. Thus, only nuclear fission meets the twin criteria of technological feasibility and adequate resource base. Each of the controversial issues surrounding nuclear fission energy is examined in some detail. The conclusion is reached that none is serious, and that nuclear fission offers by far the best energy source from environmental, economic, longevity, and overall safety standpoints. (auth)

SITING

6767 (BNL—20594) **Preliminary assessment of a hypothetical nuclear energy center in New Jersey: executive summary.** (Brookhaven National Lab., Upton, N.Y. (USA)). Nov 1975. Contract E(30-1)-16. 20p. Dep. NTIS $6.50.

Site selection aspects are summarized for a nuclear energy center in New Jersey. This analysis, which was intended to be representative of coastal locations in general, included consideration of energy demand projections, power transmission, organizational issues, siting constraints, land use issues, environmental issues, taxation, and institutional and political issues. Recommendations are made for follow-on studies. (DG)

RADIOACTIVE EFFLUENTS

6768 (UNI-SA—14) **Characterization of argon-41 production at N Reactor Hanford Reservation, Washington.** Cucchiara, A.L. (United Nuclear Industries, Inc., Richland, Wash. (USA)). 1 Dec 1975. 9p. (CONF-760202—16). Dep. NTIS $4.50.

From 9. topical symposium on operational health physics; Denver, Colorado, USA (9 Feb 1976).

As a result of normal N Reactor operation, approximately 50,000 curies of ^{41}Ar are released to the atmosphere at Hanford each year. Although the total population whole-body dose of 1.1 man-rem/year due to these ^{41}Ar emissions is very small compared to the total population whole-body dose of 27,000 man-rem/year due to natural background, efforts are being directed towards reducing the ^{41}Ar emissions. Analyses of the potential sources of ^{41}Ar in N Reactor systems have been conducted. At least 70 percent of the total quantity of Ar that is released to the atmosphere is attributable to Ar that is present within the reactor gas system. Sources of Ar that have been investigated include entrance of air within the gas dryers, back diffusion of air through a reactor wall seal, dissolved Ar in the reactor cooling water, Ar blanket on the control rod hydraulic fluid, entrance of air during reactor shutdown periods, and air within the flux monitor detectors. (auth)

RESEARCH, TEST, EXPERIMENTAL, ZERO-POWER, AND TRAINING REACTORS AND SUBCRITICAL ASSEMBLIES

6769 (BNL—20627) **Brookhaven Reactor Experiment Control Facility, a distributed function computer network.** Dimmler, D.G.; Greenlaw, N.; Kelley, M.A.; Potter, D.W.; Rankowitz, S.; Stubblefield, F.W. (Brookhaven National Lab., Upton, N.Y. (USA)). Nov 1975. 12p. (CONF-751116—15). Dep. NTIS $4.50.

From Nuclear science symposium; San Francisco, California, USA (17 Nov 1975).

A computer network for real-time data acquisition, monitoring and control of a series of experiments at the Brookhaven High Flux Beam Reactor has been developed and has been set into routine operation. This reactor experiment control facility presently services nine neutron spectrometers and one x-ray diffractometer. Several additional experiment connections are in progress. The architecture of the facility is based on a distributed function network concept. A statement of implementation and results is presented. (auth)

6770 (CONF-750827—, pp 325-344) **Program plan for decontamination and decommissioning the Materials Testing Reactor at the INEL.** Jones, T.F. (Aerojet Nuclear Corp., Idaho Falls, ID). Sep 1975.

From Conference on decontamination and decommissioning of ERDA facilities; Idaho Falls, Idaho, USA (19 Aug 1975).

In Proceedings of the first conference on decontamination and decommissioning (D and D) of ERDA facilities.

A discussion is presented of a program plan developed for the dismantling of the Materials Testing Reactor located in the Testing Reactor Area (TRA) of the Idaho National Engineering Laboratory. Included are the scope of work, dismantling problems resulting from the nature of construction of the MTR, and a program plan for physically dismantling the reactor. (auth)

6771 (CONF-750977—, pp 17.1-17.16) **Limitations of EBR-II rod-drop tests and proposed improvements using frequency-response testing.** Foltman, A.J. (Argonne National Lab., IL). 1975.

From 2. power plant dynamics, control and testing symposium; Knoxville, Tennessee, USA (3 Sep 1975).

In Proceedings of the second power plant dynamics, control and testing symposium.

The rod-drop technique currently used at EBR-II and some of its limitations are described. A proposed technique to provide improved measurements that uses discrete binary input signals is discussed. (auth)

6772 (COO—3409-4) **Twentieth annual progress report of the Pennsylvania State University Breazeale Nuclear Reactor, July 1, 1974—June 30, 1975.** Totenbier, R.E. (ed.). (Pennsylvania State Univ., University Park (USA). Dept. of Nuclear Engineering). Jun 1975. Contract AT(11-1)-3409. 80p. Dep. NTIS $6.00.

Activities are described under the headings of personnel; administration; facility operation; education and training; radionuclear applications laboratory; facility research utilization; and theses, publications, and reports. (DG)

6773 (DP-MS—75-68) **Scheduling and recording of reactor maintenance and testing by computer.** Gray, P.L. (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River

Lab.). 1975. Contract AT(07-2)-1. 14p. (CONF-751101—64). Dep. NTIS $4.50.

From Joint meeting of the American Nuclear Society and the Atomic Industrial Forum; San Francisco, California, USA (16 Nov 1975).

The use of a computer program, Maintenance Information and Control (MIAC), at the Savannah River Laboratory (SRL) assists a small operating staff in maintaining three research reactors and a subcritical facility. The program schedules and defines preventive maintenance, schedules required periodic tests, logs repair and cost information, specifies custodial and service responsibilities, and provides equipment maintenance history, all with a minimum of record-keeping. (auth)

6774 (GEAP—14002) **FTR grid-spaced assembly design basis report.** Kaplan, S.; Feerick, B.T.; Moron, J.V.; Allen, D.C. (General Electric Co., Sunnyvale, Calif. (USA). Breeder Reactor Dept.). May 1975. Contract AT(04-3)-893. vp. AT.

The Grid-Spaced Driver Assembly (GSDA) is being developed for use at LMFBR core design and operating conditions as an alternate fuel rod support system to the wire-wrap design. The projected benefits include a design alternative for extended life because of the grid's greater compliance, i.e., greater tolerance to differential planar swelling, and an LMFBR driver assembly that is reliable, safe, and economical. The GSDA design utilizing the straight-wave beam grid-spacer concept was evaluated in this report for irradiation in FTR. Three such GSDAs are being fabricated for irradiation in FTR. The design of these GSDAs is based on the experience gained from conducting the F9E and F9F grid spaced assemblies in EBR-II and a program of out-of-pile testing and development. The GSDA design and the associated design methods will be evaluated and improved based on a comparison of the predicted performance summarized in this report with the actual performance observed during the interim and post-irradiation examination. 43 references. (auth)

6775 (HEDL-TME—75-93) **Installation of the FFTF in-vessel handling machine into a sodium environment.** Carver, J.R.; Teal, G.R.; Waldo, J.B. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Nov 1975. Contract AT(45-1)-2170. 37p. AT.

The FFTF in-vessel handling machine engineering model was successfully installed in the sodium/argon environment of the composite reactor component test activity. Since all of the components of the FFTF large component handling system were not available, special equipment and procedures were required to accomplish the installation. Highlighting the transfer was the successful use of a cylindrical plastic shroud, 42 feet long and 8.5 feet in diameter, to exclude air from the CRCTA vessel while the IVHM was lowered into position. (auth)

6776 (HEDL-TME—75-98) **Sodium fire protection by space isolation, open catch pan and nitrogen flooding: FFTF proof test F5.** Boehmer, W.D.; Hilliard, R.K. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Oct 1975. Contract AT(45-1)-2170. 90p. AT.

A large-scale sodium fire extinguishment test was performed to demonstrate the adequacy of the FFTF secondary sodium fire protection system. Twenty-three hundred pounds of sodium at 1100°F were spilled into an air filled cell which had a steel catch pan protecting the concrete floor and walls. The fire was self-extinguished when the oxygen in the relatively leak tight cell was consumed by sodium-oxygen reaction. Nitrogen flooding was started after 15 minutes to maintain an inert atmosphere during cooling. Only 5.7 percent of the sodium was reacted during the test. Approximately 100 lb. of water were released from the concrete, one tenth of which reacted to form hydrogen. It was concluded that all aspects of the test results were predictable and that the FFTF secondary sodium fire protection system was verified. (auth)

6777 (HEDL-TME—75-99) **BICM-1 instrumented irradiation of boron carbide.** Pitner, A.L. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Oct 1975. Contract AT(45-1)-2170. 65p. AT.

Eighteen boron carbide specimens were irradiated for 355 effective full power days in the EBR-II to maximum burnups of 82 x 10^{20} captures/cm^3. Baseline specimens were patterned after FFTF reference boron carbide, and material variables of ^{10}B enrichment, pellet density, grain size, and stoichiometry were investigated in the test. Irradiation temperatures ranged from 1175°F to 1570°F. Each specimen was individually instrumented to measure temperature and helium release continuously during irradiation. Post-irradiation examination provided information on pellet integrity, swelling, tritium retention, and compatibility with stainless steel containment components. (auth)

6778 (LA—6016-SOP) **Technical specifications for the Pajarito Site Critical Experiments Facility.** Paxton, H.C. (Los Alamos Scientific Lab., N.Mex. (USA)). Jun 1975. Contract W-7405-ENG-36. 9p. Dep. NTIS $4.00.

This document is to satisfy the requirement for technical specifications spelled out in ERDA Manual Chapter 0540, "Safety of ERDA-Owned Reactors." Technical specifications are defined in Sec. 0540-048, and the requirement for them appears in Sec. 0540-015. The following technical specifications replace the document, "Operating Limits for the Los Alamos Critical Assembly Facility," revised May 27, 1971. (auth)

6779 (ORNL-TM—5111) **Oak Ridge Research Reactor quarterly report, April, May, and June of 1975.** Hurt, S.S. III; Lance, E.D. (Oak Ridge National Lab., Tenn. (USA)). Nov 1975. Contract W-7405-eng-26. 37p. Dep. NTIS $4.00.

The ORR operated at an average power level of 29.8 MW for 85.5 percent of the time during April, May, and June of 1975. Twelve fuel elements were declared spent (53.3 percent average burnup) during the quarter, while seventeen new elements were placed in service. Four shim-rod elements were retired from service at an average burnup of 64.6 percent. The reactor was shutdown on thirteen occasions, three of which were unscheduled. Two end-of-cycle shutdowns accounted for 79.1 percent of the total downtime. The remaining downtime was used principally for refueling, experimental work, and maintenance. Maintenance activities, both mechanical and instrument, were essentially routine in nature. Special tests or measurements completed during the quarter included flux mapping for core Nos. 125A and 126A. (auth)

6780 (ORNL-TM—5169) **High Flux Isotope Reactor quarterly report, April, May, and June of 1975.** McCord, R.V.; Corbett, B.L. (Oak Ridge National Lab., Tenn. (USA)). Nov 1975. Contract W-7405-eng-26. 19p. Dep. NTIS $4.00.

The replacement of the permanent beryllium reflector was started this quarter. A reexamination of the cracks in this assembly, conducted one fuel cycle before the replacement started, disclosed new cracks or extensions of old cracks on both the inside and outside surfaces. Despite the damage it had sustained, the cracked beryllium was removed in one piece by the end of the quarter. After the reactor was shut down, a test of journal-type bearings on one control plate indicated that this bearing has the potential to replace the troublesome ball bearings. (auth)

6781 (ORNL-TM—5183) **Absolute neutron spectrum emerging through the large beam collimator from the TSR-II reactor at the Tower Shielding Facility.** Maerker, R.E.; Muckenthaler, F.J. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 26p. AT.

The neutron spectral intensities in a 51-group structure together with the angular distributions in an 8-angle quadrature set are presented which describe the surface leakage from the hemispherical pressure vessel surrounding the TSR-II reactor at the Tower Shielding Facility. These data may be used as free-field source terms in the calculations of experiments performed using the large beam collimator, and were derived from many different measurements made at various positions in the beam that were used to normalize ANISN calculations of the pressure vessel leakage. (auth)

6782 (ORNL-TM—5225) **Determination of the neutron energy and spatial distributions of the neutron beam from the TSR-II in the large beam shield.** Clifford, C.E.; Muckenthaler, F.J. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 50p. Dep. NTIS $5.50.

The TSR-II reactor of the ORNL Tower Shielding Facility has recently been relocated within a new, fixed shield. A principal feature of the new shield is a beam port of considerably larger area than that of its predecessor. The usable neutron flux has thereby been increased by a factor of approximately 200. The bare beam neutron spectrum behind the new shield has been experimentally determined over the energy range from 0.8 to 16 MeV. A high level of fission product gamma ray background prevented measurement of bare beam spectra below 0.8 MeV, however neutron spectra in the energy range from 8 keV to 1.4 MeV were obtained for two simple, calculable shielding configurations. Also measured in the present work were weighted integral flux distributions and fast neutron dose rates. (auth)

6783 **HFBR tailored-beam facility.** Chrien, R.E. (Brookhaven National Lab., Upton, NY); Rimawi, K.; Wasson, O.A.; Greenwood, R.C. pp 341-345 of In Neutron capture gamma-ray spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2. international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974).

See CONF-740920—.

A flexible filtered neutron beam facility has been installed at the High Flux Beam Reactor at Brookhaven. The characteristic parameters of the various beam filters, iron/aluminum, lithium, and bismuth are given. Examples of the application of these beams to experiments on neutron capture γ-rays are discussed. (auth)

PLUTONIUM AND ISOTOPE PRODUCTION, CHEMONUCLEAR, MATERIALS TESTING, AND MATERIALS PROCESSING REACTORS

6784 (DP—1390) **Confinement of airborne radioactivity. Progress report, January—December 1974.** Dexter, A.H.; Evans, A.G.; Jones, L.R. (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Lab.). 1974. Contract AT(07-2)-1. 56p. Dep. NTIS $5.50.

Several commercial activated carbons, marketed for iodine removal in reactor off-gas cleanup systems, were evaluated for iodine penetration at elevated temperatures (4 hr at 180°C), and the penetration data varied widely. Subsequent chemical analysis of the samples indicated a strong correlation between the atom ratio of iodine to potassium (I/K) in the carbon and the high-temperature performance data. Iodine penetration tests were also performed on several carbons in an intense gamma radiation field (greater than 10^7 rads/hr). Test data show that carbons intentionally exposed to high concentrations of DOP aerosol performed as well as unexposed carbons. Studies of the rate of evaporation of elemental iodine from aqueous solutions indicated that significant quantities of I_2 might be expected to become airborne within a short period of time (5 hr) after release to open ponds. Addition of sodium thiosulfate to the solution substantially reduced the evaporative loss of iodine; however, the effects of high-intensity radiation fields on iodine-thiosulfate solutions remain to be evaluated. Small HEPA filters containing filter media of the type used in the Savannah River confinement system were exposed to reactor building air and a high-intensity radiation field. Following this exposure, they were tested for flow performance under simulated accident conditions. Radiation exposure slightly impaired the performance of new filters and improved the performance of service-aged filters. Service aging effects on filter performance were far more significant than radiation effects. (auth)

PROPULSION REACTORS

6785 (AI-AEC—12738) **SNAP Reactor Aerospace Nuclear Safety Program. Annual report, GFY 1968.** Detterman, R.L. (Atomics International Div., Canoga Park, Calif. (USA)). 15 Oct 1968. Contract AT(04-3)-701. 19p. Dep. NTIS $4.50.

Declassified 23 Oct 1975.

Techniques were developed for calculating the effects of Gd-155 addition to SNAP reactors. Gadolinium oxide was successfully added to nickel and rolled into foils 2 mils thick; it was demonstrated that these foils are compatible with the SNAPTRAN machine. An operating manual for the intrinsic subcriticality experiments using the SNAPTRAN machine was completed, and reviews with appropriate safety authorities were started. Test procedures for the experimental program were completed and approved, and checkout was begun. (auth)

6786 (DC—60-5-24) **Thrust requirements for supersonic airplanes.** Thome, P.G.; Nicoll, H.E. (General Electric Co., Cincinnati, Ohio (USA). Aircraft Nuclear Propulsion Dept.). 28 Apr 1960. 46p. Dep. NTIS $5.00.

Declassified 13 Sep 1973.

The cruise and take-off thrust requirements of nuclear supersonic airplanes designed for Mach numbers of 1.5, 2, 2.5 and 3 are presented. The requirements are expressed as a function of power plant plus crew shield weight and flight altitude. The total weight of the nuclear propulsion system was varied from 140,000 pounds to 340,000 pounds and the flight altitude from 20,000 to 80,000 feet. In addition the thrust requirements of a nuclear version of the B-70 are given as a function of total nuclear propulsion system weight and flight Mach number. (auth)

REACTOR SAFETY

6787 (AI-ERDA—13155) **Annual technical progress report nuclear safety characterization of sodium fires and fast reactor fission products, government fiscal year 1975.** (Atomics International Div., Canoga Park, Calif. (USA)). 15 Aug 1975. Contract AT(04-3)-824. 53p. Dep. NTIS $5.45.

Progress is reported in the areas of sodium jet dispersal tests, stationary sodium drop tests, SOMIX code development, buoyant bubble rise tests, aerosol leakage, fuel and fission product release from burning sodium, and at-temperature properties of fuel mixture. (GD)

6788 (ANCR—1207) **Transient three-dimensional thermal-hydraulic analysis of nuclear reactor fuel rod arrays: general equations and numerical scheme.** Wnek, W.J.; Ramshaw, J.D.; Trapp, J.A.; Hughes, E.D.; Solbrig, C.W. (Idaho National Engineering Lab., Idaho Falls (USA)). Nov 1975. Contract E(10-1)-1375. 47p. Dep. NTIS $5.45.

A mathematical model and a numerical solution scheme for thermal-hydraulic analysis of fuel rod arrays are given. The model alleviates the two major deficiencies associated with existing rod array analysis models, that of a correct transverse momentum equation and the capability of handling reversing and circulatory flows. Possible applications of the model include steady state and transient subchannel calculations as well as analysis of flows in heat exchangers, other engineering equipment, and porous media. (auth)

6789 (ANCR—1235) **Experiment data report for Semiscale Mod-1 test S-02-5 (blowdown heat transfer test).** (Idaho National Engineering Lab., Idaho Falls (USA)). Dec 1975. Contract E(10-1)-1375. 97p. Dep. NTIS $6.50.

Recorded test data are presented for Test S-02-5 of the Semiscale Mod-1 blowdown heat transfer test series. Test S-02-5 is one of several Semiscale Mod-1 experiments conducted to investigate the thermal and hydraulic phenomena accompanying a hypothesized loss-of-coolant accident in a water-cooled nuclear reactor system and to provide data for the assessment of the Loss-of-Fluid Test (LOFT) design basis. Test S-02-5 was conducted from an initial cold leg fluid temperature of 544°F and an initial pressure of 2,253 psia. A simulated double-ended offset shear cold leg break was used to investigate the system response to a depressurization transient with full core power (1.6 MW). An electrically heated core was used in the pressure vessel to simulate the effects of a nuclear core. System flow was set to achieve the full design core temperature differential of 66°F. The flow resistance of the intact loop was based on core area scaling. During system depressurization, core power was reduced from the initial level of 1.6 MW in such a manner as to simulate the surface heat flux response of the LOFT nuclear fuel rods until such time that departure from nucleate boiling occurs. (auth)

6790 (ANCR—1237) **Experiment data report for semiscale Mod-1, test S-02-7. Blowndown heat transfer test.** Crapo, H.S.; Jensen, M.F.; Sackett, K.E. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). Nov 1975. Contract E(10-1)-1375. 134p. Dep. NTIS $5.45.

Recorded test data are presented for Test S-02-7 of the Semiscale Mod-1 blowdown heat transfer test series conducted to investigate the thermal and hydraulic phenomena accompanying an hypothesized loss-of-coolant accident (LOCA) in a water-cooled nuclear reactor system and to provide data for the assessment of the Loss-of-Fluid Test (LOFT) design basis. Test S-02-7 was conducted from an initial cold leg fluid temperature of 543°F and an initial pressure of 2,263 psia. A simulated double-ended offset shear cold leg break was used to investigate the system response to a depressurization transient with full design core power (1.6 MW). An electrically heated core was used in the pressure vessel to simulate the effects of a nuclear core with power set to provide a flat radial power profile. System flow was set to achieve the full design core temperature differential of 66°F. Blowdown to the pressure suppression system was accomplished without simulated emergency core cooling injection or pressure suppression system coolant spray. The uninterpreted data from Test S-02-7 are presented for future data analysis and test results reporting activities. The data, presented in the form of graphs in engineering units, have been analyzed only to the extent necessary to assure that they are reasonable and consistent. Also included as an appendix are selected data from a test identified as Test S-02-7C. This test was an initial attempt at Test S-02-7 in which an inadvertent power trip occurred at 2.3 seconds after rupture. Selected data comparisons of the results from Test S-02-7 and S-02-7C are presented to indicate the repeatability of system behavior. (auth)

6791 (ANCR—1239) **Evaluation of ECC related phenomena during semiscale MOD-1 isothermal tests.** Hanson, D.J.; French, R.T.; Shaffer, C.J. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). Nov 1975. Contract E(10-1)-1375. 43p. Dep. NTIS $5.45.

Selected experimental data from tests performed during the Semiscale Mod-1 isothermal test series are analyzed. The analysis is confined to data that describe phenomena related to the injection of emergency core coolant (ECC). The analysis is directed at

the ECC related phenomena in the intact loop cold leg, inlet annulus, downcomer, and lower plenum because, depending on injection location, some or all of these components will be in contact with the ECC as it flows to a position where cooling of an active core could result. Specifically, the condensation phenomena that occur in the intact loop cold leg, inlet annulus, and downcomer are analyzed along with dowmcomer heat transfer counter-current flow phenomena to determine their effects on ECC delivery. The effectiveness of injecting ECC at various locations in the Semiscale Mod-1 system is evaluated. (auth)

6792 (ANS-SD—15) **Proceedings of the special session on plant and equipment design features for radiation protection, New Orleans, Louisiana, June 8—13, 1975.** (American Nuclear Society, Oak Ridge, Tenn.). Nov 1975. 78p. (CONF-750661—1). Dep. NTIS $5.45.

From Special session of the ANS on plant and equipment and design features for radiation protection; New Orleans, Louisiana, USA (8 Jun 1975).

Six papers are included on design and operating procedures to assure protection of nuclear power plant personnel from excessive radiation doses. A separate abstract was prepared for each paper. (HDR)

6793 (ANS-SD—15, pp 1-20) **Shielding design for better plant availability.** Biro, G.G. (Gibbs and Hill, Inc., New York). Nov 1975.

From Special session of the ANS on plant and equipment and design features for radiation protection; New Orleans, Louisiana, USA (8 Jun 1975).

In Proceedings of the special session on plant and equipment design features for radiation protection, New Orleans, Louisiana, June 8—13, 1975.

Design methods are described for providing a shield system for nuclear power plants that will facilitate maintenance and inspection, increase overall plant availability, and ensure that manrem exposures are as low as practicable. (HDR)

6794 (ANS-SD—15, pp 21-26) **Design features to reduce occupational exposure.** Adam, J.A.; DiSabatino, A.A. Jr.; Vanasse, R.E. (Stone and Webster Engineering Corp., Boston). Nov 1975.

From Special session of the ANS on plant and equipment and design features for radiation protection; New Orleans, Louisiana, USA (8 Jun 1975).

In Proceedings of the special session on plant and equipment design features for radiation protection, New Orleans, Louisiana, June 8—13, 1975.

Some of the design principles which are important considerations in the evolution of a nuclear power plant design to ensure that occupational radiation exposures can be minimized are discussed. Emphasis is placed on the design features affecting the basic layout and equipment locations within the plant. Examples are provided showing how these design objectives are realized in the Stone and Webster Reference Nuclear Power Plant Design, with particular emphasis on the Annulus Building portion of the reference plant. Design features which are useful in reducing occupational exposure during normal operation are discussed initially, followed by those that chiefly affect exposures during maintenance activity. Finally, those provisions in the design which assist in preventing the spread of radioactive contamination are presented. (auth)

6795 (ANS-SD—15, pp 27-34) **Architect engineer balance-of-plant radiological design considerations.** Piccot, A.R. (Sargent and Lundy Engineers, Chicago). Nov 1975.

From Special session of the ANS on plant and equipment and design features for radiation protection; New Orleans, Louisiana, USA (8 Jun 1975).

In Proceedings of the special session on plant and equipment design features for radiation protection, New Orleans, Louisiana, June 8—13, 1975.

Methods which are or may be used by Architect Engineers in dealing with the problems of radiological safety in the design of a nuclear power plant are discussed. The bases and basic requirements for a radiation protection program are briefly noted. Requirements in the areas of planning, organization, responsibilities and implementation of radiation protection are discussed. Lists of safety tasks which should be performed during the various design phases are presented. (auth)

6796 (ANS-SD—15, pp 35-47) **Control of occupational radiation exposures in TVA nuclear power plants design and operating philosophy.** Stone, G.F.; Beasley, E.G. Jr.; Zobel, W.; Belvin, E.A. Jr.; Lyon, M. (Tennessee Valley Authority, Chattanooga). Nov 1975.

From Special session of the ANS on plant and equipment and design features for radiation protection; New Orleans, Louisiana, USA (8 Jun 1975).

In Proceedings of the special session on plant and equipment design features for radiation protection, New Orleans, Louisiana, June 8—13, 1975.

Because of the Tennessee Valley Authority commitment to nuclear power, a formal program has been initiated for keeping in-plant personnel radiation exposures as low as practicable (ALAP). The design and operating philosophy relative to implant radiation control at the Browns Ferry plant is described, and the plans for implementation of ALAP criteria in future plants are discussed. (HDR)

6797 (ANS-SD—15, pp 49-70) **Minimizing radiation exposures in PWR plants.** Clemons, L. Jr. (Westinghouse Electric Corp., Monroeville, PA); Battaglia, J.A. Nov 1975.

From Special session of the ANS on plant and equipment and design features for radiation protection; New Orleans, Louisiana, USA (8 Jun 1975).

In Proceedings of the special session on plant and equipment design features for radiation protection, New Orleans, Louisiana, June 8—13, 1975.

Control of implant personnel radiation exposures at nuclear power plants has been accomplished through administrative control and maintenance procedures in operating plants and in the design and layout of new plants. Experience gained at operating pressurized water reactors is reviewed to illustrate how the guidelines for as low as practicable exposure are addressed. (HDR)

6798 (ANS-SD—15, pp 71-74) **Labyrinth design in nuclear power plants.** Kaiseruddin, M. (Sargent and Lundy Engineers, Chicago). Nov 1975.

From Special session of the ANS on plant and equipment and design features for radiation protection; New Orleans, Louisiana, USA (8 Jun 1975).

In Proceedings of the special session on plant and equipment design features for radiation protection, New Orleans, Louisiana, June 8—13, 1975.

Labyrinth entrances to shielded rooms are extensively employed in nuclear power plants as they provide economical and convenient radiation protection for the outside areas. A most commonly used simple labyrinth arrangement was analyzed with radiation source energy and strength (indirectly) as parameters. Design curves were developed for the simple labyrinth. It was determined that such simple labyrinths are adequate for high energy gamma ray sources, but may not be so for many of the low energy sources. (auth)

6799 (BMI—1941) **Experimental studies of ECC delivery in a 1/15-scale transparent vessel model.** Flanigan, L.J.; Cudnik, R.A.; Denning, R.S. (Battelle Columbus Labs., Ohio (USA)). Nov 1975. 89p. Dep. NTIS $6.00.

A description is presented of experimental studies in a $^{1}/_{15}$-scale transparent vessel model of a 4-loop PWR, operated at approximately atmospheric pressure. The studies are being conducted to extend the understanding of steam-water interaction phenomena and of processes associated with a loss-of-coolant accident. (auth)

6800 (BMI-X—662) **Aerosol behavior modeling for fast reactor safety: FY 1975 annual report.** Gieseke, J.A.; Reed, L.D. (Battelle Columbus Labs., Ohio (USA)). Oct 1975. Contract W-7405-eng-92. vp. Dep. NTIS $5.45.

Information is presented concerning the compilation of data for the analysis of aerosol behavior for fast reactor safety, HAARM-1 users' manual, improved particle size distribution representation, aerosol agglomerate behavior, radiation effects on aerosol behavior, and sensitivity analyses. 13 references (DCC)

6801 (BMI-X—663) **Work plan: aerosol behavior modelling for fast reactor safety.** Reed, L.D.; Gieseke, J.A. (Battelle Columbus Labs., Ohio (USA)). Aug 1975. Contract W-7405-eng-92. 22p. Dep. NTIS $4.00.

A work plan for efforts on aerosol behavior modeling for fast reactor safety in the time period from July 1, 1974, through June 31, 1977, (FY 75, 76, and 77) is described. The overall goals of this study are to provide improvements in the capability to predict aerosol behavior in postulated fast reactor accident situations and verify this behavior to the extent possible by comparison with available experimental results. (auth)

6802 (BMI-X—666) **Aerosol behavior modeling for fast reactor safety. Quarterly progress report for July—September 1975.** Reed, L.D.; Gieseke, J.A. (Battelle Columbus Labs., Ohio (USA)). 30 Oct 1975. Contract W-7405-eng-92. 20p. Dep. NTIS $4.00.

Progress at Battelle has been made in three general areas. A sodium oxide aerosol generator has been designed and constructed for use with a Millikan cell apparatus in studying sodium oxide agglomerate characteristics. The experimental design, rationale, and procedure are discussed in detail. Also, further improvements have

been made in the HAARM-1 aerosol behavior code and a second generation code, HAARM-2, has been developed. Furthermore, a preliminary comparison between the PARKISEKO-III code and the HAA-3B model has been performed. Results for a particular case are discussed. (auth)

6803 (BNL—50457) **NALAP: an LMFBR system transient code.** Martin, B.A.; Agrawal, A.K.; Albright, D.C.; Epel, L.G.; Maise, G. (Brookhaven National Lab., Upton, N.Y. (USA)). Jul 1975. Contract E(30-1)-16. 149p. Dep. NTIS $8.75.

NALAP is a LMFBR system transient code. This code, adapted from the light water reactor transient code RELAP 3B, simulates thermal-hydraulic response of sodium cooled fast breeder reactors when subjected to postulated accidents such as a massive pipe break as well as a variety of other upset conditions that do not disrupt the system geometry. Various components of the plant are represented by control volumes. These control volumes are connected by junctions some of which may be leak or fill junctions. The fluid flow equations are modeled as compressible, single-stream flow with momentum flux in one dimension. The transient response is computed by integrating the thermal-hydraulic conservation equations from user-initialized operating conditions by an implicit numerical scheme. Point kinetics approximation is used to represent the time dependent heat generation in the reactor core. (auth)

6804 (BNWL—1924-1) **Core thermal model development and experiments. Progress report, 1 July 1974—31 December 1974.** Rowe, D.S. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jul 1975. 61p. Dep. NTIS $4.00.

Analytical and experimental studies are being performed at the Pacific Northwest Laboratory to improve methods of thermal-hydraulic analysis for reactor cores. The work is primarily concerned with developing computational methods that can consider multidimensional two-phase hydrodynamic phenomena in reactor cores during postulated accidents. The basic approach being taken in the analytical part of this program is to adapt the subchannel analysis concept to analysis of a nuclear core. This is being done by representing the core as a matrix of control volumes. Transport equations are written for two-phase flow, and are then solved by a digital computer. This provides a multidimensional representation of the core from which it may be possible to define simpler analysis methods: i.e., define the minimum amount of detail required for core thermal analysis. The experimental part of this program is concerned with validating the computational model. Experiments are presently concerned with flow distributions in rod bundles containing flow blockages and with the evaluation of laser-Doppler techniques to measure two-phase hydrodynamic phenomena. Major efforts have been made to improve the computational capability of the COBRA code for reactor safety analysis; compare the code with experimental data; evaluate the code for core analysis; and experimentally measure velocity in rod bundles containing flow blockage. (auth)

6805 (CONF-750607—30) **Use of vertical slip flow and flooding models in LOCA analysis.** Fischer, S.R. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). 1975. Contract AT(10-1)-1375. 4p. Dep. NTIS $4.50.

From American Nuclear Society meeting; New Orleans, Louisiana, USA (8 Jun 1975).

Vertical slip flow and flooding models, which have been incorporated in a version of the RELAP4 computer code by Aerojet Nuclear Company have led to significant improvements in modeling nuclear reactor coolant system phenomena during postulated large and small break loss-of-coolant accidents. The vertical slip flow model computes the separated fluid component velocities and directions at vertical flow junctions. Use of the slip model allows the energy transfer between volumes to be based on individual liquid and vapor component flows rather than on the net junction flow. Continuity and momentum equations are unaffected by the addition of slip. The vertical flow slip model logic is based on the assumption that gravity forces dominate causing slip between phases. 7 references (auth)

6806 (CONF-750607—31) **Vertical slip flow and flooding models in LOCA analysis.** Fischer, S.R. (Aerojet-General Corp., Sacramento, Calif. (USA)). Jun 1975. 27p. Dep. NTIS $4.50.

From American Nuclear Society meeting; New Orleans, Louisiana, USA (8 Jun 1975).

Vertical slip flow and flooding models have been incorporated in a version of the RELAP4 computer code in order to better model nuclear reactor coolant system phenomena during postulated large and small break loss-of-coolant accidents. Much of the complex hydrodynamic phenomena believed to occur during ECC injection, ECC bypass, liquid penetration into the downcomer, and lower plenum entrainment is multidimensional in nature leading to modeling difficulties when the present nonslip version of RELAP4 is used. Flooding type models in combination with vertical slip flow can be used to improve modeling of ECC bypass and liquid entrainment phenomena during reversed core flow. Applications to the analysis of core flow blockage phenomena also exist. Flooding used in this discussion denotes Wallis countercurrent type flooding phenomena which limits the maximum liquid downflow for a given vapor upflow. Flooding as used here does not refer to the deluge type reflood of a core. (auth)

6807 (CONF-750827—, pp 83-118) **Elk River Reactor dismantling.** Davis, B.J. (Chicago Operations Office, Argonne, IL). Sep 1975.

From Conference on decontamination and decommissioning of ERDA facilities; Idaho Falls, Idaho, USA (19 Aug 1975).

In Proceedings of the first conference on decontamination and decommissioning (D and D) of ERDA facilities.

The dismantling program was carried out in three overlapping phases: the planning phase which included the preliminary planning and selection of the dismantling approach, the dismantling phase which included all work performed to remove the reactor facility and restore the site to its pre-reactor condition, and the closeout phase which included the final site survey and efforts necessary to terminate the AEC license and contract. Of particular interest was the use of a remotely operated plasma cutting torch to section the pressure vessel internals, the pressure vessel and the outer thermal shield, the use of explosives in removal of the biological shield and the method of establishment of the criteria for material disposal. (auth)

6808 (CONF-750827—, pp 119-137) **Program plan for removal of the materials test reactor overhead working reservoir.** Lunis, B.C. (Aerojet Nuclear Co., Idaho Falls, ID). Sep 1975.

From Conference on decontamination and decommissioning of ERDA facilities; Idaho Falls, Idaho, USA (19 Aug 1975).

In Proceedings of the first conference on decontamination and decommissioning (D and D) of ERDA facilities.

The salient features are described of the removal of a contaminated facility, the Materials Test Reactor (MTR) Overhead Working Reservoir (OWR) from the Test Reactor Area (TRA) to the Radioactive Waste Management Complex (RWMC) at the Idaho National Engineering Laboratory (INEL). The 125 ton OWR was an overhead 160,000 gallon capacity tank approximately 193 feet high which supplied cooling water to the MTR. Radiation at ground level beneath the tank was 5 mR/hr and approximately 800 mR/hr at the exterior surface of the tank. Sources ranging from 3 R/hr to in excess of 500 R/hr existed within the tank. The tank interior was contaminated with uranium, plutonium, and miscellaneous fission products. The OWR was lowered to ground level with the use of explosive cutters. Dismantling, decontamination, and disposal was performed by Aerojet Nuclear Company (ANC) maintenance forces. (auth)

6809 (CONF-750827—, pp 139-151) **Decontamination and disposition of Hallam and Piqua reactors.** Heine, W.F.; Ureda, B.F. (Atomics International, Canoga Park, CA). Sep 1975.

From Conference on decontamination and decommissioning of ERDA facilities; Idaho Falls, Idaho, USA (19 Aug 1975).

In Proceedings of the first conference on decontamination and decommissioning (D and D) of ERDA facilities.

The Hallam Nuclear Power Facility, a sodium cooled, graphite moderated, 256 Mw(t) power reactor, went critical in 1962, was shut down as a result of moderator problems in 1964, and was decommissioned in 1969. The Piqua Nuclear Power Facility, an organic cooled, 45 Mw(t) power reactor went critical in 1963, was shut down in 1966 because of coolant problems, and was decommissioned in 1969. Fuel, coolant, and support systems of both reactors were removed from the site. The reactor vessels are entombed at their sites. Remaining systems at Hallam were sealed in the underground vaults and were then covered with six feet of earth. The Piqua vessel is sealed in the concrete reactor containment building. The state of Nebraska is responsible for monitoring 3×10^5 curies in 1969. The Piqua site was purchased by the U. S. Government and then leased to the City of Piqua. The remaining radioactivity at Piqua was 2.6×10^5 curies. (auth)

6810 (CONF-750827—, pp 253-274) **Decontamination and decommissioning experience at Experimental Breeder Reactor No. 1.** Kendall, E.W. (Aerojet Nuclear Corp., Idaho Falls, ID). Sep 1975.

From Conference on decontamination and decommissioning of ERDA facilities; Idaho Falls, Idaho, USA (19 Aug 1975).

In Proceedings of the first conference on decontamination and decommissioning (D and D) of ERDA facilities.

A description is presented of the experience obtained from decontamination and decommissioning of the Experimental Breeder Reactor No. 1 located at the Idaho Nuclear Engineering

Laboratory, Scottsville, Idaho. Included are the planning, preparation, and operations associated with the removal and processing of radioactively contaminated sodium-potassium eutectic alloy (NaK) and decontamination and decommissioning of the facility. (auth)

6811 (CONF-750827—, pp 417-438) **Preparations for decontamination and disposition of the Sodium Reactor Experiment (SRE) and other ERDA facilities at AI.** Heine, W.F.; Graves, A.W. (Atomics International, Canoga Park, CA). Sep 1975.

From Conference on decontamination and decommissioning of ERDA facilities; Idaho Falls, Idaho, USA (19 Aug 1975).

In Proceedings of the first conference on decontamination and decommissioning (D and D) of ERDA facilities.

The program plan for the decontamination and disposition of facilities at the Sodium Reactor Experiment and other ERDA-owned, AI-operated, radioactive facilities is described. The program objective along with a description of each of the subject facilities is presented. A description of the organizational structure within supporting the program is given. The elements of planning required to prepare for the task are detailed, including the requirements for cost and schedule control. Progress to date and the future plans are presented. The available technology utilized in the program is described. (auth)

6812 (CONF-750827—, pp 439-461) **Decommissioning plan for the heavy water components test reactor.** Field, F.R. (E.I. du Pont de Nemours and Co., Aiken, SC). Sep 1975.

From Conference on decontamination and decommissioning of ERDA facilities; Idaho Falls, Idaho, USA (19 Aug 1975).

In Proceedings of the first conference on decontamination and decommissioning (D and D) of ERDA facilities.

Three alternatives to decommission the Heavy Water Components Test Reactor (HWCTR) have been analyzed. The major elements of the alternatives are shown. No final choice has been made between alternatives, and all are feasible. Protective confinement is advantageous as long as current activities onsite require limited access by the general public, and because excellent confinement of the residual activity (2.3×10^4 curies) is provided by in situ dry storage as the radiation from ^{60}Co diminishes. Entombment provides the most-secure confinement of the activity at some increased cost; in 35 years, the activity will decay to 2×10^3 curies and consist primarily of ^{63}Ni. Dismantling HWCTR has no apparent advantages, other than a demonstration at the Savannah River site, because of the long-term commitment to safeguarding radioactive material; the relative cost is high. Selection of a plan for decommissioning will depend on criteria that are presently being formulated within ERDA and other regulatory bodies. (auth)

6813 (CONF-751157—1) **Status of accident analysis for fast breeder reactors.** Hummel, H.H. (Argonne National Lab., Ill. (USA)). Nov 1975. 23p. Dep. NTIS $4.50.

From 2. annual post-accident heat removal info exchange meeting; Albuquerque, New Mexico, USA (13 Nov 1975).

There are still considerable deficiencies in computational tools available even for following accidents to initial disassembly. Present indications are that such a disassembly will be mild, without much sensitivity of this result to modeling assumptions, but the LOF-driven TOP requires better analysis. It is not possible at present to follow the course of an accident mechanistically beyond a first disassembly. Plugging and recriticality are possibilities, but so far do not appear likely to lead to a substantial increase in accident severity. It seems unlikely that the destructive work in an HCDA will be large enough to cause difficulties in containment. However, complete melting of the core material is a desirable assumption for PAHR analysis. It is not possible at present to predict what the relative upward and downward ejection of core material will be. (auth)

6814 (EUR—5309e) **Second specialist meeting on sodium/fuel interaction in fast reactors, Ispra, Italy, 21—23 November 1973.** Randles, J. (comp. and ed.). (Commission of the European Communities, Luxembourg). 1973. 602p. (CONF-731126—). EUR B.Fr. 1.500.

From 2. specialist meeting on sodium fuel interaction in fast reactors; Ispra - Varese, Italy (21 Nov 1973).

Each of the twenty-four papers presented has been separately indexed and abstracted. Abstracts of three papers appeared in previous issues of NSA. (DG)

6815 (EUR—5309e, pp vp Paper SNI 2/19) **UO_2/Na interactions: recent in- and out-of-pile experiments in the U.S. and their interpretation for fast reactor safety analysis.** Speis, T.P. (Atomic Energy Commission, Washington, DC); Fauske, H.K. 1973.

From 2. specialist meeting on sodium fuel interaction in fast reactors; Ispra - Varese, Italy (21 Nov 1973).

In Second specialist meeting on sodium/fuel interaction in fast reactors.

A brief summary is presented of studies related to LMFBR fuel-coolant interactions. Included are TREAT and EBR-II in core tests and laboratory experimental studies of interactions with sodium and molten uranium dioxide. (DG)

6816 (EUR—5309e, pp vp Paper SNI 2/6) **Evaluation of conservatism in analysis of fuel—coolant interaction.** Reynolds, A.B. (Univ. of Virginia, Charlottesville); Erdman, C.A.; Garner, P.L.; Haas, P.M.; Allen, C.L. 1973.

From 2. specialist meeting on sodium fuel interaction in fast reactors; Ispra - Varese, Italy (21 Nov 1973).

In Second specialist meeting on sodium/fuel interaction in fast reactors.

Two general approaches have evolved in the analysis of FCI. The first has been to assume that a large FCI can occur and then to estimate its consequences. The second approach has been to attempt to gain a basic understanding of the fragmentation and heat-transfer processes and thereby to determine whether a large FCI is a real possibility. The reported absence of energetic FCIs when fuel enters sodium, both in dropping experiments and in TREAT tests, has led some to contend that a large FCI may be impossible. The interpretations of these test results and their applicability to large-scale accidents, however, are still subject to question. Although further parametric analysis of FCI is definitely needed, it appears at this time that improved, more realistic models will result in reduced estimates of the mechanical work. It is not yet clear that appropriately conservative estimates will be low enough to change dramatically the nature of the containment picture, even after all model improvements are included. Hopefully results of investigations into the basic FCI phenomena will provide clear definitive evidence that conditions leading to a very energetic FCI cannot occur. It is apparent that for the present both approaches must continue to be pursued. (auth)

6817 (GA-A—13672) **GCR Safety Program quarterly progress report for the period ending 30 September 1975.** (General Atomic Co., San Diego, Calif. (USA)). 31 Oct 1975. Contract E(04-3)-167. vp. Dep. NTIS $5.45.

The program covers development of safety and safety-related studies to better understand and more accurately define safety characteristics and safety margins of GCRs under postulated accident conditions. The work reported here includes core seismic studies, high-temperature gas-cooled reactor (HTGR) accident initiation and progression analysis, the setting up of a reliability data bank, safety liaison with RRD-selected contractors, and safety research on core-released radioactivity, secondary containment gas flammability, and containment atmosphere response during postulated accident situations. (auth)

6818 (GEAP—13317—11) **BWR blowdown heat transfer. Eleventh quarterly progress report, January 1—March 31, 1975.** (General Electric Co., San Jose, Calif. (USA)). Apr 1975. Contract AT(04-3)-189. 143p. Dep. NTIS $6.00.

Evaluation of data from the first 49-rod bundle has been completed. Data from four blowdown heat transfer (BDHT) tests including NRC Standard Problem No. 4 are reported. The evaluation of independent parameter variations is presented. A measurement uncertainty analysis has been completed and the results are presented. Testing with the second 49-rod bundle has been initiated. (auth)

6819 (GEAP—13923-12) **Safety engineering twelfth quarterly report, May—July 1975.** (General Electric Co., Sunnyvale, Calif. (USA). Breeder Reactor Dept.). Aug 1975. Contract AT(04-3)-893. 50p. AT.

Progress is reported in the following LMFBR safety engineering areas: fuel and cladding motion studies, evaluation of nonprototypic effects, and accident code development. (DG)

6820 (GEAP—14048) **Status of post-accident core retention concepts and models.** Gluekler, E.L. (comp.). (General Electric Co., Sunnyvale, Calif. (USA). Breeder Reactor Dept.). Jul 1975. Contract AT(04-3)-893. vp. AT.

A review and evaluation of core retention concepts and related calculation models is presented with the intent to identify potential problem areas and development needs regarding experimental support and calculational model development. Several systems can be considered potentially viable candidates: the crucible, the trays, and the sacrificial bed. Of these concepts, the crucible and sacrificial bed seem to be more suitable than the tray concept for ex-vessel use. The crucible and trays, and also a combination of the two, have advantages over the sacrificial bed as an in-vessel system. Simple concrete barriers or holes underneath the containment may also represent design alternatives, if it can be demonstrated that the radiological consequences are acceptable. Since the post-meltdown conditions have a significant effect on core retention design concepts, the accident scenario, spatial core

debris distribution and decay heating rates were studied. Secondary criticality considerations also present an important design aspect. During the melt-through sequence, recriticality could be prevented through proper design measures. In the steady-state configuration reached in the core retainer, recriticality is more easily manageable. Material studies were initially focused on a materials selection for individual core retention concepts. Based on preliminary evaluations, including the velocity of the meltfront, materials compatibility, availability, and fabricability, MgO, TiC, ZrO_2, Al_2O, and graphite emerged as relatively attractive sacrificial bed materials. Crucibles may consist of stainless steel with a protective coating of UO_2 or graphite (or possibly Cu). A molten layer model and sacrificial bed heat transfer code were developed and are described in an appendix. (auth)

6821 (HEDL-SA—764) **Accuracy of coarse mesh, three-dimensional calculations for quasi-static fast reactor transient analysis.** Nelson, J.V.; Hardie, R.W. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 1975. 29p. (CONF-750607—37). Dep. NTIS $4.00.

From American Nuclear Society meeting; New Orleans, Louisiana, USA (8 Jun 1975).

In analyses of hypothetical loss of flow accidents in the Fast Test Reactor (FTR), the safety analysis programs SAS and MELT are currently in use. These programs require as input a number of parameters including distributions of power density, fuel, sodium and stainless steel reactivity coefficients and Doppler weighting coefficients. Since the performing of 12-group three-dimensional calculations using models with normal mesh structure would be prohibitively expensive if calculation of physics parameters for more than a few configurations during the time frame of the accident was deemed necessary, the possibility of using a coarse mesh, few group model has been investigated. The accuracy of safety parameters computed using such a model is examined. (auth)

6822 (HEDL-TME—75-47(Vol.1)) **Volume 1. Base technology FSAR support document: prefailure transient behavior and failure threshold. Status report, January 1975.** Baars, R.E.; Culley, G.E.; Davis, R.T.; Henderson, R.G.; Scott, J.H. (comps.). (Hanford Engineering Development Lab., Richland, Wash. (USA)). Nov 1975. Contract E(45-1)-2170. 136p. Dep. NTIS $5.45.

A comprehensive compilation of the current (January 1975) state-of-the-art understanding of fuel pin response to reactivity insertion events up to and including failure threshold is presented. All mixed oxide fuel, transient overpower tests conducted to date are described and the data collected therein are presented. Current understanding of fuel pin cladding failure mechanisms is discussed, and interpretations of fuel pin cladding failure thresholds are presented as revealed by individual tests and by the several tests collectively. Plans for future tests are discussed. (auth)

6823 (HEDL-TME—75-47(Vol.2)) **Volume 2. Base technology FSAR support document: prefailure transient behavior and failure threshold. Status report, January 1975.** Barrs, R.E.; Culley, G.E.; Davis, R.T.; Henderson, R.G.; Scott, J.H. (comps.). (Hanford Engineering Development Lab., Richland, Wash. (USA)). Nov 1975. Contract E(45-1)-2170. 269p. Dep. NTIS $7.60.

The FFTF fuel pin design and fabrication data, irradiation history and postirradiation examination results are summarized for the General Electric and Argonne National Laboratory transient experiments in TREAT. (auth)

6824 (HEDL-TME—75-47(Vol.3)) **Volume 3. Base technology FSAR support document: prefailure transient behavior and failure threshold. Status report, January 1975.** Baars, R.E.; Culley, G.E.; Davis, R.T.; Henderson, R.G.; Scott, J.H. (comps.). (Hanford Engineering Development Lab., Richland, Wash. (USA)). Nov 1975. Contract E(45-1)-2170. 295p. Dep. NTIS $10.00.

The FFTF fuel pin design and fabrication data, irradiation histories, and postirradiation examination results are summarized for the HEDL/TREAT transient test experimental programs. For each experiment, the data include: (a) fuel pin fabrication parameters, (b) steady-state irradiation history, (c) transient test design conditions, (d) transient test data, and (e) postirradiation examination results. (auth)

6825 (HEDL-TME—75-70) **Reactor and safety engineering technical progress report, April, May, June 1975.** Slember, R.J. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Aug 1975. Contract AT(45-1)-2170. 94p. AT.

Progress is described in the areas of core physics, radiation and shield analysis, reactor dynamics, reactor safety, safety development, and systems safety analysis. (DG)

6826 (LA—6106-MS) **Preliminary topical report on comparison reactor disassembly calculations.** McLaughlin, T.P. (Los Alamos Scientific Lab., N.Mex. (USA)). Nov 1975. Contract W-7405-ENG-36. 36p. Dep. NTIS $4.00.

Preliminary results of comparison disassembly calculations for a representative LMFBR model (2100-l voided core) and arbitrary accident conditions are described. The analytical methods employed were the computer programs: FX2-POOL, PAD, and VENUS-II. The calculated fission energy depositions are in good agreement, as are measures of the destructive potential of the excursions, kinetic energy, and work. However, in some cases the resulting fuel temperatures are substantially divergent. Differences in the fission energy deposition appear to be attributable to residual inconsistencies in specifying the comparison cases. In contrast, temperature discrepancies probably stem from basic differences in the energy partition models inherent in the codes. Although explanations of the discrepancies are being pursued, the preliminary results indicate that all three computational methods provide a consistent, global characterization of the contrived disassembly accident. (auth)

6827 (LA—6127-MS) **Effects of neutron streaming and geometric models on molten fuel recriticality accidents.** McLaughlin, T.P. (Los Alamos Scientific Lab., N.Mex. (USA)). Oct 1975. Contract W-7405-Eng-36. 14p. Dep. NTIS $4.00.

A postulated fast reactor accident which has been extant for many years is a recriticality following partial or complete core melting. Independently of the cause or probability of such a situation, certain cases can be defined and some facets of the dynamic history of these cases can be described with more than enough accuracy for safety considerations. Calculations were made with the PAD code for systems with 10 vol percent voids and varying reactivity insertion rates. Additionally, two distinct geometric and equation of state models were investigated in conjunction with a model which accounted for possible neutron streaming reactivity effects. Significant results include fission and kinetic energy, temperatures and pressures. (auth)

6828 (LA-UR—75-2316) **Analytical models and related experiment needs for post-accident heat-removal research.** Boudreau, J.E. (Los Alamos Scientific Lab., N.Mex. (USA)). Nov 1975. Contract W-7405-Eng-36. 9p. (CONF-751141—4). Dep. NTIS $3.50.

From Meeting on fuel and clad motion diagnostics in LMFBR safety test facilities; Albuquerque, New Mexico, USA (11 Nov 1975).

A brief discussion is presented of critical LMFBR post-accident heat removal phenomena and the related generic phenomena which must be included in any realistic analysis of the behavior of post-accident core debris. The current status of modeling in this area is described, and experimental needs are listed. (DG)

6829 (ORNL—5083) **SIMTRAN I: a computer code for the simultaneous calculation of oxygen distributions and temperature profiles in Zircaloy during exposure to high-temperature oxidizing environments.** Malang, S. (Oak Ridge National Lab., Tenn. (USA)). Nov 1975. Contract W-7405-eng-26. 145p. Dep. NTIS $7.60.

SIMTRAN I is a Fortran IV computer program written for the IBM 360/91 system which solves SIMultaneously the TRANsport equations for both heat and mass flow for the one-dimensional, multiphase, moving-boundary, transient-temperature transport problem in a finite-geometry system defined by cylindrical coordinates. The code utilizes an ideal diffusion model which requires uniform layer growth of all phases and assumes the existence of thermodynamic equilibrium at all interfaces at all times. While SIMTRAN was constructed specifically for the consideration of oxidation phenomena during the reaction of Zircaloy fuel tubes with steam under high-temperature transient oxidation conditions, only minor changes are necessary to make it generally applicable to other materials and a number of oxidation, diffusion, and heat-transfer problems. A variety of boundary-condition options permit the mathematical simulation of a wide range of oxidation experiments. The basic operational input to the code, which must include physical property, thermodynamic, and kinetic data over the desired temperature range, was selected from a variety of literature sources.

6830 (ORNL-TM—4984) **Common-mode failure mechanisms in nuclear plant protection systems.** Hayden, K.C. (Oak Ridge National Lab., Tenn. (USA)). Dec 1975. Contract W-7405-eng-26. 31p. AT.

A broad class of failure mechanisms that can cause common-mode failures in nuclear plant protection systems and other high-reliability systems was studied. This class includes causes of multiple failures that in the past have not been widely recognized as common-mode failure mechanisms. These mechanisms were deduced from reactor operating experience, reports, and related literature. Several categories of multiple failure mechanisms are

proposed as a starting point for the development of design and operating guidelines for reducing the probability of common-mode failures. Some of these categories represent classes of failure mechanisms that will be either difficult or impossible to incorporate correctly into numerical failure-probability analysis techniques which are based on reliability data on individual components and which assume no coupling, or at least some well-understood coupling, of redundant devices or subsystems. (auth)

6831 (ORNL-TM—5075) **HTGR safety studies. Quarterly progress report for the period ending March 31, 1975 for the Gas-Cooled Reactors Branch, Division of Reactor Licensing.** Sanders, J.P. Jr. (Oak Ridge National Lab., Tenn. (USA)). Nov 1975. Contract W-7405-eng-26. 42p. Dep. NTIS $4.00.

Information is presented concerning cooling system performance during post shutdown operation, core auxiliary coolant system accident performance, loss of forced circulation thermal analysis, and air ingress rates to the primary system following a DBDA. (DCC)

6832 (ORNL-TM—5140) **Evaluation of thermal response in Fort St. Vrain reactor primary system to a design basis depressurization accident followed by cooling with two Pelton wheel drives operating at 7000 rpm.** Sanders, J.P.; Turner, W.D.; Ball, S.J.; DeVault, R.M.; Giles, G.E.; Paul, D.D. (Oak Ridge National Lab., Tenn. (USA)). Dec 1975. Contract W-7405-eng-26. 46p. Dep. NTIS $5.50.

Independent computations have been performed at ORNL to determine the thermal and hydraulic response of the primary system of the Fort St. Vrain reactor to a specified design basis depressurization accident (DBDA). For this accident it is stated that two of the four auxiliary drives on the circulators start operating at 7000 rpm after a 5-min delay. The calculations at ORNL supported the values given by the General Atomic Co. for primary system flow and pressure loss, and they confirmed the heat removal capacity of the flooded steam generators. The fuel and outlet helium temperatures calculated by ORNL generally reached higher values during the transient due to the fact that the ORNL calculations were performed using a single-channel calculation that could not include the effect of interregional heat conduction. An ORNL code that is developmental, but which includes interregional conduction, agrees well with the GAC values. The results of these calculations are presented graphically. 18 references. (auth)

6833 (ORNL-TM—5144) **INGRES: a computer code for the rate of air ingress into an HTGR following a design-basis depressurization accident.** Reid, R.L.; Sanders, J.P. (Oak Ridge National Lab., Tenn. (USA)). Dec 1975. Contract W-7405-eng-26. 32p. Dep. NTIS $5.00.

The computer program INGRES was written to calculate the rate of air ingress into the prestressed concrete reactor vessel after a design-basis depressurization accident in a high-temperature gas-cooled reactor. The model includes the free convection loop that can occur in a cold-leg break, the expansion and contraction air exchange mechanisms, and the conversion of oxygen to carbon monoxide. Results are presented for the 2000-MW(t) Summit Power Station and the 3000-MW(t) Fulton Generating Station and are compared to computational results provided by the General Atomic Company. The results agree reasonably well even though some differences exist in the two models. (auth)

6834 (ORNL-TM—5205) **Monthly progress report for November 1975 for the HTGR safety studies for the Division of Technical Review, U.S. Nuclear Regulatory Commission.** Sanders, J.P. (Oak Ridge National Lab., Tenn. (USA)). Dec 1975. Contract W-7405-eng-26. 9p. Dep. NTIS $4.50.

Progress concerning the analysis of the transient response of HTGR systems under abnormal conditions is briefly reported. (JWR)

6835 (ORNL-TM—5217) **Monthly highlights for Office of Nuclear Regulatory Research Programs at Oak Ridge National Laboratory, November 1975.** Fee, G.G. (comp.). (Oak Ridge National Lab., Tenn. (USA)). Dec 1975. Contract W-7405-eng-26. 27p. Dep. NTIS $5.00.

Technical highlights and cost/budget data are presented for the following programs: heavy section steel technology, fission product beta and gamma energy release, LOCA release from LWR fuel, multirod burst tests, Nuclear Safety Information Center, PWR blowdown heat transfer-separate effects, zircaloy fuel cladding collapse studies, zirconium metal-water oxidation kinetics, transient release from LMFBR fuel, HTGR safety analysis and research, and design criteria for piping and nozzles. (DG)

6836 (SAND—75-0632) **Light water reactor safety research program. Quarterly report, July—September 1975.** Butcher, B.M. (ed.). (Sandia Labs., Albuquerque, N.Mex. (USA)). Dec 1975. Contract AT(29-1)-789. 72p. Dep. NTIS $6.00.

Progress is reported in the following areas: molten core-concrete interactions study, and steam explosion phenomena.

6837 (SAND—75-0653) **Statistical analysis of LOCA, FY 75 report.** Steck, G.P.; Dahlgren, D.A.; Easterling, R.G. (Sandia Labs., Albuquerque, N.Mex. (USA)). Dec 1975. Contract AT(29-1)-789. 81p. Dep. NTIS $6.00.

The propagation of probability distributions through a complicated function to form the resulting distribution is considered. Seven techniques are discussed and the Monte Carlo and Response Surface methods are evaluated on two test problems. The results indicate reasonably accurate results can be obtained and that the Response Surface is the most efficient technique. (auth)

6838 (SAND—75-6101) **Status of Sandia Laboratories debris bed studies program. Post accident heat removal information exchange, November 13—14, 1975.** Rivard, J.B. (Sandia Labs., Albuquerque, N.Mex. (USA)). Nov 1975. 17p. (CONF-751140—1). Dep. NTIS $4.50.

From Meeting on post-accident heat removal information exchange; Albuquerque, New Mexico, USA (13 Nov 1975).

The current status (November 1975) of the Sandia Laboratories Debris Bed Studies Program is reviewed. The primary objective of the initial experiments is the characterization of the sodium dryout instability in a bed of frozen fuel particulate which might lead to remelting and the associated high temperatures in a Liquid-Metal Fast Breeder Reactor. Progress is delineated in experiment and pre-experiment test planning, safety analysis, helium cooling loop assembly, experiment capsule design, diagnostic and control instrumentation, experiment operating characteristics, and fuel specification. It is concluded that, barring unforeseen delays, the initial experiments should be performed near mid-1976. (auth)

ENERGY STORAGE

6839 (ERDA-tr—83) **Energy transfer and energy storage.** Heinz, W. 1974. Translation of VDI—208. 21p. Dep. NTIS $3.50.

The increasing consumption of electrical energy together with the growing proportion of nuclear energy as a primary energy source require new concepts both with respect to energy transfer as well as energy storage. Research on the use of low temperature technology is reported. Other advanced transfer and storage systems are compared. (auth)

MAGNETIC

6840 (ERDA-tr—81) **Superconducting inductive energy storage systems.** Heinz, W.; Komarek, P. 1974. Translation of pp 103-107 of VDI report No. 223. 10p. Dep. NTIS $4.50.

Superconducting magnetic systems store energy with high density. They could therefore be applied both as a fast dischargeable pulse storage system for high momentary power flux as well as as a slow dischargeable large storage system. Whereas use as a high current pulse source appears promising with plasma physics experiments and with the future fusion reactor, the technical feasibility and economic viability of a superconducting large storage system with an energy content of a number of GWh must still be considered as uncertain. After a few main considerations, superconducting energy storage systems as current pulse generators and for use in the grid are discussed. The outlook of possible parameters and technical problems of larger plants are given. Finally, a report is given concerning experiments with energy storage systems in the 100 kWs range and the future prospects provided on possible parameters and technical problems of larger installations. (auth)

BATTERIES

DESIGN AND DEVELOPMENT

6841 (COO—2564-1) **Basic research on ceramic materials for energy storage and conversion systems. Progress report, April 1, 1975—November 30, 1975.** Whitmore, D.H. (Northwestern Univ., Evanston, Ill. (USA)). Dec 1975. Contract E(11-1)-2564. 7p. Dep. NTIS $3.50.

The present research program involves utilizing appropriate probes for movement of ionic and electronic charge carriers in ceramic materials suitable for solid electrolyte and electrode applications in high-performance, secondary battery and fuel cell systems. Special emphasis is placed on developing a better un-

derstanding of the effects of structure, impurities, and composition on transport mechanisms and on developing detailed knowledge of the kinetics and mechanisms of reactions occurring (on a microscopic scale) at the electrode—electrolyte interfaces of energy storage and conversion systems. (auth)

6842 Anhydrous hydrogen fluoride electrolyte battery. (to Atomic Energy Commission). US Patent Application 266,092(70). 26 Jun 1972. 12p.

It is an object of the invention to provide a primary cell or battery using ammonium fluoride--anhydrous hydrogen fluoride electrolyte having improved current and power production capabilities at low temperatures. It is operable at temperatures substantially above the boiling point of hydrogen fluoride. (GRA)

6843 Materials corrosion in molten-salt lithium—sulfur cells. Battles, J.E.; Mrazek, F.C.; Tuohig, W.D.; Myles, K.M. (Argonne National Lab., IL). pp 20-31 of In Corrosion problems in energy conversion and generation. Tedman, C.S. Jr. (ed.). Princeton, NJ; Electrochemical Society, Inc. (1974).

From Proceedings of the symposium on corrosion problems in energy conversion and generation; New York, New York, USA (15 Oct 1974).

See CONF-7410138—.

Lithium/sulfur secondary batteries of high specific energy and high specific power are being developed at Argonne National Laboratory for electric-powered vehicles and for load-leveling energy storage applications. Because of the corrosiveness of the cell environment, extensive corrosion testing of potential construction materials is being conducted to enable selection of low-cost materials for cell components. Corrosion tests of numerous materials indicated that the stainless steels and Armco Electromagnet Iron are compatible with the LiCl—KCl electrolyte at 400°C and, hence, suitable for cell housings and assorted hardware. Iron current collectors in the positive electrode showed acceptable compatibility with FeS as the active material, but not with FeS_2. Molybdenum, on the other hand, appeared to be completely resistant to attack in the positive-electrode environment for both FeS and FeS_2 active materials. Corrosion tests at 400°C of various ceramics indicated that only Y_2O_3 is immune to attack by liquid lithium; other materials showed marginal compatibility (e.g., BN, BeO, $CaZrO_3$, MgO, and $MgAl_2O_4$). In-cell tests demonstrated the successful application of BN fabric separators in cells with solid Li—Al negative electrodes. 2 figures, 5 tables (auth)

6844 Vibration-proof battery. Kosuge, T.; Sano, I. (to Furukawa Denchi Kabushiki Kaisha). US Patent 3,909,294. 30 Sep 1975. Filed date 1 Mar 1973. 4p.

A vibration-proof battery of the type including an electrode plate group holding member adapted to compress from above and electrode plate group positioned on a rest and contained in a battery casing is described. The holding member is formed so as to have along its lower edge comb teeth-shaped projections, and is arranged so that each of the projections compresses the upper edge of a corresponding one of positive and negative electrode plates constituting the electrode plate group. 2 figures (auth)

6845 Lithium—chlorine battery design. Zeitner, E.J. Jr.; Kennedy, J.H. (to Secretary of the Navy). US Patent 3,909,297. 30 Sep 1975. Filed date 10 May 1968. 8p.

A lithium--chlorine fuel cell is described which has a porous graphite cathode through which gaseous chlorine is diffused into an electrolyte-containing reaction chamber and a molten lithium-wettable metallic fibrous matrix anode which is capable of delivering molten lithium to the reaction chamber. A method for activating the fuel cell is presented. A battery having at least one of the fuel cells attached in series is discussed. 2 figures (auth)

PERFORMANCE AND TESTING

6846 (SAND—75-0536) **Temperature and shock testing of lithium-organic electrolyte cells.** Levy, S.C. (Sandia Labs., Albuquerque, N.Mex. (USA)). Jan 1976. Contract AT(29-1)-789. 17p. Dep. NTIS $4.50.

Honeywell G2655 lithium cells were tested over the temperature range -40° to +70°C and subjected to shock levels up to 17,000 g's. Output at -40°C was approximately 50 percent of that at +25°C, while at +70°C the output was 150 percent that at +25°C. Shock had no noticeable effect on performance. 99 figures, 6 tables. (auth)

6847 Solid electroyte thermal battery. Nissen, D.A.; Carlsten, R.W. (Sandia Labs., Albuquerque, NM). pp 675-684 of In Fast ion transplant solids, solid state batteries devices. Van Gool, W. (ed.). Amsterdam; North-Holland (1973).

A study was conducted to determine the feasibility of a thermally activated battery of four cells based on the system Ag/AgI, CdI_2(5 mole percent)/C, RbI_3. The battery was tested over the range 175 to 300°. At 200° a steady-state current density of 50 to 100 mA/cm² was obtained. (RWR)

MATERIALS, COMPONENTS, AND AUXILIARIES

6848 Positive seal for batteries employing plastic casings. Schenk, R.L. Jr. (to Gould Inc.). US Patent 3,909,300. 30 Sep 1975. Filed date 21 Jan 1974. 22p.

Methods and apparatus for positive displacement bonding and, more particularly, for automatically forming, on a continuous, reproducible basis, fusion bonds devoid of structural, electrical, and cosmetic defects between two or more workpieces are described. By moving a heated electrode into the area to be bonded so as to heat and melt uniformly the portions of the workpieces to be bonded while, at the same time, displacing substantially all of the molten material from the area to be bonded into a storage area or reservoir surrounding the heated electrode where such molten material is maintained in its uniformly heated molten state, and then retracting the electrode so as to permit the molten material to return to the cavity formed by the electrode in the workpieces where such molten material is allowed to cool and solidify, a flawless bond between the workpieces is formed. Improved sealing means are also used. Thermal or fusion bonds are made in accordance with the methods of the invention and with the apparatus of the invention by a combination of elevated temperature levels sufficient to melt the material to be bonded and displacement of the molten material, as contrasted with more conventional techniques and/or apparatus, which combine elevated temperature levels and pressure. 17 figures (auth)

6849 Method of manufacturing battery plate grids. Hammond, J.E.; Williams, A. (to Joseph Lucas (Industries) Ltd.). US Patent 3,909,293. 30 Sep 1975. Priority date 29 Apr 1971, United Kingdom of Great Britain and Northern Ireland (UK). 4p.

A battery plate grid includes an open, rectangular conductive framework, a conductive battery plate lug integral with the framework, a plurality of parallel ribs extending between a pair of opposite frame members of the grid, and a plurality of strands arranged to define a lattice structure bounded by the framework, the interstices of the lattice structure being arranged to receive the active material of the battery plate. To manufacture the grid, a strip of grid material is blanked to produce a preform grid having the same weight as the finished grid and having a rectangular framework of substantially the same dimensions as that of the finished grid. The preformed grid also includes a lattice structure defined by a plurality of strands and arranged so that the dimensions of the lattice structure in a direction perpendicular to the plane of the preformed grid are less than the corresponding dimensions of the lattice structure of the finished grid. After blanking, the strands of the preformed grid are displaced in such a manner as to increase the dimension of the lattice structure in a direction perpendicular to the plane of the grid to the value required in the finished grid. 5 figures (auth)

6850 Lead storage battery. Sekido, S.; Fukuda, S. (to Matsushita Electric Industrial Co., Ltd.). US Patent 3,909,292. 30 Sep 1975. Priority date 27 Oct 1971, Japan. 12p.

A lead storage battery with electrodes made of non-woven fabric of lead fibers is described. The electrodes are porous and have a large specific surface area. This structure results in a higher utilization rate of lead and higher energy density. 21 figures, 2 tables (auth)

6851 Batteries comprising vented electrodes and method of using same. Carr, P. (to Energy Development Associates). US Patent 3,909,298. 30 Sep 1975. Filed date 16 Jul 1973. 10p.

An electrode for use in an electrical energy storage device is described which comprises a first side and a second side, thereby forming a channel for flow of an electrolyte with gas dissolved therein, whereby the first side has holes for venting of undissolved gas. 4 figures (auth)

6852 Negative electrode for solid electrolyte cells. Galli, R.; Olivani, F. (to Montecatini Edison SpA). US Patent 3,912,536. 14 Oct 1975. Priority date 27 Mar 1971, Italy. 6p.

An alkali metal negative electrode is disclosed for solid electrolyte electrochemical devices, consisting essentially of a solution of an alkali metal in one or more aprotic organic solvents. Complexing agents for the alkali metal may be present in the solution. The alkali metal solution may be saturated with respect to the alkali metal, which may be present as solid phase. The aprotic organic solvents may be selected from the class consisting of ethers, polyethers, N-hexalkylphosphotriamides and tertiary amines. 1 figure, 2 tables (auth)

ENERGY MANAGEMENT AND CONSERVATION POLICY

RESEARCH AND DEVELOPMENT

6853 (ERDA—64, pp 1-3) **ERDA orientation.** Brogan, J.J. 1975.

From Automotive power systems contractors coordination meeting; Ann Arbor, Michigan, USA (6 May 1975).

In Automotive Power Systems contractors coordination meeting.

The background, organization, and objectives of the United States Energy Research and Development Administration (ERDA) are presented. (PMA)

SYSTEMS STUDIES AND TOTAL ENERGY

6854 (IPP—4/132) **Approach toward determining and assessing effects of innovations in energy supply by means of a combined energy and economy model.** Buende, R. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F.R. Germany)). May 1975. 79p. (In German). Dep. NTIS (US Sales Only) $5.00.

The energy system is represented as part of a national economy and analyzed by means of the input - output technique. The development of a mathematical model based on two existing models using the same technique is described. This will allow the time behavior of the energy system and the total system to be simulated and optimized for different objective functions and constraints. In addition, consequences of impacts on the system, e.g., the development of a new energy source such as the fusion reactor, can be shown. 46 references. (auth)

ENVIRONMENT

6855 **Biological risks of electricity production.** Comar, C.L. (Electric Power Research Inst., Palo Alto, CA). *Aware;* No. 63, 2-6(Dec 1975).

The fundamental comparison that needs to be made is the biological risk of three options: (a) building coal power plants; (b) building nuclear plants; and (c) building no plants at all. The biological risks from the coal plants may or may not be in the high-probability range; from nuclear, they are in the low-probability range. There are no data or documented opinions on the risks of having an inadequate supply of electricity. Intuitively, however, these risks might well be higher than those of the other two options if one takes into account such factors as: (1) increasing unreliability of electricity supply; (2) older plants becoming more polluting; and (3) constraints on economic growth that could cause severe dislocations before we have been able to change our social systems to meet the new conditions. Our new generating plants will be a mix of coal and nuclear, and the biological risks of each should be acceptable in terms of associated benefits. Efforts should be made to improve technologies to reduce biological risks, but money and manpower should not be expended to reduce small risks even further at the expense of other risks that are left unattended. (auth, Summary)

6856 **POLLUTION ENGINEERING TECHNIQUES: AN OVERVIEW INTRODUCTION TO THE PROBLEM, PHILADELPHIA, PENNSYLVANIA, OCTOBER 22—25, 1973.** Ann Arbor, MI; United States of America (USA); Ann Arbor Science Publishers, Incorporated (1974). 216p. (CONF-7310118—). Ann Arbor Science Publishers, Inc., MI.

From 2. annual international pollution engineering congress; Philadelphia, Pennsylvania, USA (22 Oct 1973).

The 34 papers presented at the Conference are compiled. Together they offer an overview and introduction to the many varied aspects of pollution engineering, including federal guidelines, methods of compliance, waste processing and disposal, control of noise and odor, and conservation. An abstract was prepared for one paper that was prepared under ERDA sponsorship. (JSR)

FOSSIL FUELS

COAL

6857 (BM-IC—8678) **Reserve base of coal for underground mining in the western United States.** Matson, T.K.; White, D.H. Jr. (Bureau of Mines, Washington, D.C. (USA)). 1975. 240p. Publications Distribution Center, Bureau of Mines, 4800 Forbes Ave., Pittsburgh, PA 15213.

The coal reserve base in the Western United States is presented for coalbeds amenable to extraction by underground mining methods. The Federal Bureau of Mines has abstracted data on the quality and quantity of coal resources/reserves from numerous state and federal publications and modified such data as necessary to allow computer storage and retrieval. Tonnages are compiled by state, county, coalbed, and rank, and allotted to sulfur categories by statistical apportionment. The coal reserve base in those states west of the Mississippi River, amenable to underground mining, is estimated to be approximately 131 billion tons. Of this total, about 30.8 billion tons are bituminous coal, 100.2 billion tons are subbituminous coal, and 126.4 million tons are anthracite. Lignite is not considered for underground mining in this report. Included in this report is a glossary of terms applicable to a classification system for coal resources and reserves as jointly defined by the Bureau of Mines and U. S. Geological Survey. The purpose of this system is to provide for direct comparison or compilation of various resource/reserve data. (auth)

6858 (BM-IC—8685) **Strip-mining techniques to minimize environmental damage in the upper Missouri River Basin states.** Persse, F.H. (Bureau of Mines, Washington, D.C. (USA)). 1975. 55p. GPO $1.15.

To meet escalating energy requirements, substantial increases in production from the strippable coal and lignite deposits in eastern Montana, western North Dakota, and northeastern Wyoming already have occurred, and further expansions are expected at least until the year 2000. Such production, attributable largely to rising demand for low-sulfur coal, must be accomplished with a minimum of adverse effects on the environment. Information on geology, climate, and current land use in the Upper Missouri River basin is presented in the Bureau of Mines review as a guideline to what operators may expect during the after mining. Proven methods of protecting the air and water from pollution and of restoring mined land for other uses are described, and untried methods of land reclamation, some with equipment yet to be manufactured, are discussed as possible means of maintaining aesthetic values in the basin. Costs incurred to protect the environment are part of the production cost and thus are borne by the ultimate consumer. Unit production costs are less for the thick coal and lignite deposits of the basin than for the thinner but higher Btu coal deposits of the Eastern and Midwestern United States. Precise comparisons of environmental protection costs between mines in such disparate areas cannot be made, because of differences in physical conditions, accounting procedures, and other variables. (auth)

PETROLEUM

6859 (BM-IC—8675) **Depth and producing rate. Classification of petroleum reservoirs in the United States, 1971.** Dietzman, W.D. (Bureau of Mines, Washington, D.C. (USA)). 1971. 25p. Publications Distribution Center, Bureau of Mines, 4800 Forbes Ave., Pittsburgh, PA 15213.

This Bureau of Mines report presents a continuation of statistics pertaining to distribution of petroleum reservoirs (or fields), wells, and production by depth and producing rate classification in the United States. These statistics show the change that has occurred since results of a similar study were published by the Bureau of Mines in 1967. Data are presented in tabular form by state for the 18 principal oil-producing states and by subdivision for the two largest oil-producing states, Texas and Louisiana. Tabular summations and graphical illustrations are presented for the nation. The data are classified by 4-barrel-of-oil-per-day rate increments up to 36 barrels and one increment of greater than 36 barrels of oil per day and by 2,000-foot depth increments up to 8,000 feet and one depth increment of greater than 8,000 feet. The overall average producing rates for states and the nation have been published for many years, and although such rates are useful, they are very general descriptions of producibility. A breakdown of production, wells, and reservoirs by various depths and rates and by state or by state subdivision provides a more detailed description of producibility. (auth)

NUCLEAR ENERGY

6860 (NP—20730) **Internationalization in the sector of construction of electrical and particularly nuclear power plants.** Erdemli, H.; Real, B. (Grenoble-1 Univ., 38 (France)). Oct 1974. 237p. (In French). Dep. NTIS (US Sales Only) $9.00.

The impact of the 1973 to 1974 oil crisis on the nuclear power policies of the industrialized nations is reviewed. The con-

struction of nuclear power plants in these countries, including current projects, is examined in some detail. Some trends concerning the domination of the nuclear and electrical power plant industry by U.S.-based corporations are discussed. (JWR)

6861 Hunt for uranium heats up. Settatree, B. *Hydro News;* **62**: No. 6, 15-18(1975).

Geiger counters and pick and shovel prospecting techniques are now being aided by aircraft and the latest in technological equipment as efforts are being stepped up to find new uranium deposits in Canada. The new survey technique employs airborne gamma-ray spectrometry over areas with flat topography. Regional geochemistry is used in mountainous areas where flying is impractical. Ontario and Saskatchewan have been selected for the first year's studies and officials with plans to survey about 70 percent of the entire country within 10 years. Recent forecasts suggest that world demand will exceed existing production capacity of uranium in the early 1980s. The production and capacity forecasts of the three existing uranium mining companies--Eldorado, Rio Algom, and Denison--are reviewed. Gulf is about to begin production and the Faraday project at Bancroft will be operational in 1976. It is predicted that 6,100 tons will be produced in 1975, compared with 4,442 tons in 1974. Production is forecast to reach 16,000 tons by 1985, the production level of 1959. (MCW)

HYDROGEN AND SYNTHETIC FUELS

6862 Future United States demand patterns and the use of hydrogen. Blank, L.T. (Univ. of Texas, El Paso); Riley, R.K. pp 1105-1122 of In Hydrogen energy. Part B. Veziroglu, T.N. (ed.). New York; Plenum Publishing Corp. (1975).

From Hydrogen economy Miami energy conference; Miami Beach, Florida, USA (18 Mar 1974).

See CONF-740306—PB.

The future energy demands under the concepts of saturation and conservation are forecast for the common use areas. Details of conservation efforts in each area are given. Convertibility to hydrogen is estimated for each use area based on conservative demand projections. The estimates are made for the energy demand which is readily convertible and possibly convertible to the use of hydrogen fuel. (auth)

UNCONVENTIONAL SOURCES AND POWER GENERATION

SOLAR

6863 Solar energy: status and prospects as a national resource. Eggers, A.J. Jr. (National Science Foundation, Washington, DC). *ASHRAE (Am. Soc. Heat. Refrig. Air-Cond. Eng.) J.;* **17**: No. 11, 41-43(Nov 1975).

Applications of solar energy do not require establishing scientific feasibilities. The major problem in each application area is to develop systems that are economically competitive with alternative energy sources. This accomplishment will require innovative engineering as well as new and improved approaches to collection and conversion of solar radiation and to energy storage and transport. Important problems must also be solved dealing with social, legal, and even environmental issues which are identified with widespread implementation of solar energy systems. Solar energy research and development has been organized programmatically under six areas: Bioconversion to fuels; ocean thermal conversion; wind energy conversion; photovoltaic conversion; solar thermal conversion; and solar heating and cooling of buildings (including agricultural applications). Taken together, these six applications of solar energy technologies may provide some one-third of our energy requirements as we move into the next century. (auth)

ELECTRIC POWER GENERATION

6864 (CONF-751057—2) **Outline of the transmission line aesthetic impact evaluation process and its implementation in the general planning scheme.** Rosemarin, C.S. (Oak Ridge National Lab., Tenn. (USA)). Oct 1975. 5p. Dep. NTIS $4.50.

From Meeting on environmental analysis techniques and procedures for siting utility systems; Madison, Wisconsin, USA (20 Oct 1975).

Power transmission line routing must be considered for aesthetic, ecological, and political reasons. Aesthetic and ecological aspects are closely related and they in turn influence the political process. A method is necessary to quantitatively evaluate the aesthetic impact of proposed transmission lines and to fit the resulting instrument into a comprehensive planning scheme. Electric power transmission planning will be done for EHV and UHV ac overhead systems up to the year 2000. Aesthetics are secondary in importance to engineering and economic issues. Schematics are shown for transmission line aesthetic impact evaluation. (MCW)

TRANSPORT AND STORAGE

6865 (ERDA—64, pp 3-13) **Transportation Division goals and plans.** Brogan, J.J. 1975.

From Automotive power systems contractors coordination meeting; Ann Arbor, Michigan, USA (6 May 1975).

In Automotive Power Systems contractors coordination meeting.

The background, organization, and objectives of the Division of Transportation of the United States Energy Research and Development Administration (ERDA) are discussed. Planning and strategy center on the reduction of petroleum consumption, the development of alternative engines with multifuel capabilities, and the use of on-board energy storage, electric cars for example are discussed. (PMA)

6866 (ERDA—64, pp 13-20) **Highway Vehicle Systems planning.** Thur, G.M. 1975.

From Automotive power systems contractors coordination meeting; Ann Arbor, Michigan, USA (6 May 1975).

In Automotive Power Systems contractors coordination meeting.

A review is given of the present philosophy, objectives, and implementation strategy of the Highway Vehicle Systems Office, Transportation Division, United States Energy Research and Development Administration (ERDA). Planning efforts are divided among four branches: (1) alternate fuels and utilization; (2) heat engine systems (Diesel, Stirling, advanced gas turbine, etc.); (3) power train and vehicular systems (primarily near-term improvements); and (4) electric and hybrid systems (primarily long-term). A fifth branch for testing and evaluation is anticipated. (PMA)

CONSUMPTION AND UTILIZATION

6867 (UCID—3707(Rev.)) **Holidays, gifts, and the energy crisis.** Schipper, L. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 1 Dec 1975. 23p. Dep. NTIS $3.50.

The energy consumed to provide goods and services is discussed. Suggestions are then presented on how holiday gifts and activities could reduce associated energy needs. (auth)

6868 Energy crisis. Brennan, M.H. (Flinders Univ. of South Australia, Bedford Park). pp 1-14 of In Physics and the energy industry. Summer school in physics. Bedford Park, South Australia; Flinders University (1974).

From Summer school on physics and the energy industry; Bedford Park, Australia (Jan 1974).

See CONF-740137—.

Present and future patterns of energy consumption are described. The major energy resources including fossil fuels, fission, fusion and solar are briefly considered.

6869 Nuclear electric economy. Ross, P.N. (Westinghouse Electric Corp., East Pittsburgh, PA). pp 1287-1307 of In Hydrogen energy. Part B. Veziroglu, T.N. (ed.). New York; Plenum Publishing Corp. (1975).

From Hydrogen economy Miami energy conference; Miami Beach, Florida, USA (18 Mar 1974).

See CONF-740306—PB.

If we are to deal effectively and realistically with the energy crisis, we must sharply reduce our overwhelming dependence on oil and natural gas by shifting to an electric energy economy based on coal and uranium. To do this, we must begin now to substitute electricity for direct combustion of oil and gas in all those end uses where this is technically and economically feasible. The question is not where we are going, but rather the timing and the route by which we make the transition from the oil-gas energy economy of today to the nuclear-electric energy economy of tomorrow. (auth)

ENERGY CONVERSION

MHD GENERATORS

6870 Magnetohydrodynamic power generation. George, D.W. (Flinders Univ. of South Australia, Bedford Park). pp 99-114 of In Physics and the energy industry. Summer school in physics. Bedford Park, South Australia; Flinders University (1974).

From Summer school on physics and the energy industry; Bedford Park, Australia (Jan 1974).

See CONF-740137—.

The principles of MHD power generation are outlined and an indication is given of the present state-of-the-art. Although fossil fuels are seen as the primary source for MHD power, it is feasible that fission nuclear reactor energy could also be converted to electricity in this way. A further possibility for MHD power is the liquid-metal closed-cycle system. (AT)

DESIGN AND DEVELOPMENT

6871 (FE—1756-1) Benefits/costs of advanced power cycle research: a mid-1974 analysis. Final report. (Little (Arthur D.), Inc., Cambridge, Mass. (USA)). Dec 1975. Contract E(49-18)-1756. 83p. Dep. NTIS $5.00.

The analysis eported here was performed in mid-1974 for what was then the Office of Coal Research (and now part of the United States Energy Research and Development Administration). It was designed as a best-efforts assessment(from available information) of the benefits/costs then of planned Federal R and D programs in advanced power cycle energy systems. Two advanced power cycle technologies were selected for analysis as proxies for the many technologies within the advanced power cycle family: 1) combined cycles (specifically, an integrated gasifier combined cycle system), and 2) magnetohydrodynamics (MHD). The benefits quantified in this report are limited to those defined as the savings to be realized by the Nation as a result of having cheaper energy available through advanced power cycles systems than might be otherwise available in an uncertain future. At a discount rate of 6%, the apparent benefit/cost ratios of Federal R and D related to combined cycles and MHD were 31 and 16, respectively. The uncertainties associated with the analysis requires that these benefit/cost ratios be viewed only as an indication of the level of benefit/cost advantages to be attributed to advanced power cycle research. The sensitivity of the benefit/cost ratios important assumptions such as the price of coal is illustrated through a few sensitivity analyses. (auth)

6872 H_2—O_2 combustion powered steam-MHD central power systems. Seikel, G.R.; Smith, J.N.; Nichols, L.D. (Lewis Research Center, Cleveland). pp 969-982 of In Hydrogen energy. Part B. Veziroglu, T.N. (ed.). New York; Plenum Publishing Corp. (1975).

From Hydrogen economy Miami energy conference; Miami Beach, Florida, USA (18 Mar 1974).

See CONF-740306—PB.

Estimates are made for both the performance and the power costs of H_2-O_2 combustion powered steam-MHD central power systems. Hydrogen gas is assumed to be transmitted by pipe from a remote coal gasifier into the city and converted to electricity in a steam-MHD plant having an integral gaseous oxygen plant. These steam-MHD systems appear to offer an attractive alternative to both in-city clean fueled conventional steam power plants and to remote coal fired power plants with underground electric transmission into the city. (auth)

MATERIALS, COMPONENTS, AND AUXILIARIES

6873 Chemical stability and degradation of MHD electrodes. Bowen, H.K.; Halloran, J.W.; Petuskey, W.T. (Massachusetts Inst. of Tech., Cambridge). pp 179-211 of In Corrosion problems in energy conversion and generation. Tedman, C.S. Jr. (ed.). Princeton, NJ; Electrochemical Society, Inc. (1974).

From Proceedings of the symposium on corrosion problems in energy conversion and generation; New York, New York, USA (15 Oct 1974).

See CONF-7410138—.

Open-cycle, coal-fired MHD electrical power generators require high temperature (1300-1800°C) electrodes. The problems in long term stability of the electrodes are related to the high operating temperature, chemical compatibility with the alkali rich slag-seed mixture, and the dc-current extraction. The basic requirements for electrodes are defined and seven candidate materials, which all have adequate electrical conductivity, are discussed. The chemical stability programs for these systems with respect to temperature and sulfur and oxygen pressures are given. The stability with respect to other elements such as potassium is also discussed. Estimations of the rate of degradation are given. The concept of stabilizing or protecting the electrode at the high temperature and in the corrosive MHD environment is pursued. (auth)

6874 Corrosion studies of materials for auxiliary equipment in MHD power plants. Gannon, R.E. (Avco Everett Research Lab., Inc. MA); Hals, F.A.; Reynolds, H.H. pp 212-224 of In Corrosion problems in energy conversion and generation. Tedman, C.S. Jr. (ed.). Princeton, NJ; Electrochemical Society, Inc. (1974).

From Proceedings of the symposium on corrosion problems in energy conversion and generation; New York, New York, USA (15 Oct 1974).

See CONF-7410138—.

Under specific operational modes, the high temperature air preheater of an open cycle MHD power system will function in a molten alkali salt environment. In such an environment, liquid phase corrosion of the high temperature refractory matrix could limit the operational life of the preheater. An experimental investigation of the behavior of candidate refractories in contact with molten potassium sulfate was therefore initiated. The results indicate that the primary modes for the degradation of commercial refractory materials can be traced to the infiltration of the pores of the ceramic structure by the molten salt. The salt then appears to attack the grain boundaries of the refractory causing an expansion of the structure. Certain exceptions to this general behavior were noted and are discussed in some detail. (auth)

FUEL CELLS

ELECTROCHEMISTRY, MASS TRANSFER, AND THERMODYNAMICS

6875 Heat and mass transfer analysis of a hydrogen—oxygen fuel cell. Bayazitoglu, Y. (Middle East Technical Univ., Ankara); Smith, G.E.; Curl, R.L. pp 859-873 of In Hydrogen energy. Part B. Veziroglu, T.N. (ed.). New York; Plenum Publishing Corp. (1975).

From Hydrogen economy Miami energy conference; Miami Beach, Florida, USA (18 Mar 1974).

See CONF-740306—PB.

A model is developed using the general laws of continuity, diffusive mass transfer and heat transfer in a distributed heat and mass transfer analysis to study heat and water transport processes in a hydrogen-oxygen fuel cell. The developed model applies to fuel cells which use the technique of circulating reactant gas in excess of that consumed in the electrochemical reaction in order to remove the product water as well as heat. (auth)

ELECTROMECHANICAL CONVERTERS

SUPERCONDUCTING GENERATORS

6876 (ERDA-tr—82) Problems of cooling superconducting synchrogenerators. Hofmann, A. (Karlsruhe Univ. (TH) (F.R. Germany). Inst. fuer Experimentelle Kernphysik; Kernforschungszentrum Karlsruhe (F.R. Germany)). Mar 1975. Translation of a German report. (CONF-750359—2). 8p. Dep. NTIS $4.50.

From Spring meeting of the solid-state physicists of the DPG; Muenster, F.R. Germany (17 Mar 1975).

The development of large turbogenerators with superconducting exciter winding has moved into the area of considerable economic interest. The advantages and problems of superconductance are discussed. The problems of cooling the cold rotor are especially considered in detail. At the same time, discussions concern what thermal losses are to be expected and what effects occur with respect to coolant flow, heat transmission as well as the change of state of coolant in a rotating system as a result of centrifugal and Coriolis forces. A listing is made as to what formulations are available for solution of these problems and what investigations are to be carried out before a reliable design of a superconducting rotor can result. (auth)

ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

6877 EFFICIENT USE OF ENERGY. CONFERENCE ON THE TECHNICAL ASPECTS OF THE MORE EFFICIENT USE

OF ENERGY, PRINCETON, NJ, JULY 8—AUGUST 2, 1974. Ford, K.W.; Rochlin, G.I.; Socolow, R.H.; Hartley, D.L.; Hardesty, D.R.; Lapp, M.; Dooher, J.; Dryer, F.; Berman, S.M.; Silverstein, S.D. AIP Conference Proceedings, No. 25. New York; United States of America (USA); American Instite of Physics (1975). 316p. (CONF-740752—).

From American Physical Society, efficient use of energy) a physics perspective; Princeton, New Jersey, USA (8 Jul 1974).

A separate abstract was prepared for lack of the 13 chapters. (RCK)

BUILDINGS

6878 Physics perspective. Introduction. *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 25, 3-13(1975).

From American Physical Society, efficient use of energy) a physics perspective; Princeton, New Jersey, USA (8 Jul 1974).

See CONF-740752—.

The Introductory chapter of Part I, A Physics Perspective, includes an overall summary of the five chapters: Complementary Approaches to Energy Conservation; Second-Law Efficiency: The Role of the Second Law of Thermodynamics in Assessing the Efficiency of Energy Use; Energy Indoors; The Automobile; and Sample Industrial Processes. An extended list of selected research opportunities is given. Two Appendices, Selected Energy-Use Data and Selected Data and Conversion Factors, are included. (MCW)

6879 Second-law efficiency: the role of the second law of thermodynamics in assessing the efficiency of energy use. *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 25, 25-51(1975).

From American Physical Society, efficient use of energy) a physics perspective; Princeton, New Jersey, USA (8 Jul 1974).

See CONF-740752—.

As a general figure of merit, the first-law efficiency has several drawbacks, i.e., its maximum value depends on the system and on temperatures and may be greater than, less than, or equal to 1; it does not adequately emphasize the central role of the second law in governing the possible efficiency of energy use; and it cannot readily be generalized to complex systems in which the desired output is some combination of work and heat. Various other special and general figures of merit have been proposed, but the one recommended for general adoption is the quantity called the second-law efficiency. For any device or system, the second-law efficiency is the ratio of the least available work that could perform the task to the available work actually consumed in doing the job with a given device or system. Its maximum value is always unity, and indicates how much room there is for improvement. Power generation from fossil fuels; oil or gas-fired furnaces for space heating and cooling; and the use of heat pumps are tasks studied for calculations of available work using the second-law efficiency. The thermodynamics of available work, using compressed-air energy storage as an example, is discussed. Available work and power generation using the combustion of methane are illustrated. A national perspective on efficiency for some household appliances, industrial uses, transportation systems, and feedstock are tabulated. (MCW)

6880 Energy indoors. *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 25, 52-98(1975).

From American Physical Society, efficient use of energy) a physics perspective; Princeton, New Jersey, USA (8 Jul 1974).

See CONF-740752—.

Furnaces, water heaters, and other energy systems in a house are discussed, including such units as apartment buildings, row houses, stores, public buildings, and detached houses. Winter heating requirements for a cave and living quarters above the ground are investigated. Other factors considered include windows, fresh air, energy balancing, solar energy input, internal inputs other than the heating system, and the furnace. The six subsystems analyzed include air conditioning, heat pumps, hot water heaters, lighting, temperature control systems, and aerodynamic control. Efficiencies from the standpoint of the second law of thermodynamics are calculated for hot water heating, space heating, and air conditioning. The possibility of fuel savings arising from a hypothetical restructuring of the energy industry and of energy use such that a major portion of the supply of low-temperature heat and electricity is produced by combined systems, systems in which both the electricity and the low-temperature heat generated in a fuel-consuming device are put to use, was investigated. Recommendations are made that concern improved design of systems and research that could lead to new design. (MCW)

6881 Energy conservation and window systems. *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 25, 247-254(1975).

From American Physical Society, efficient use of energy) a physics perspective; Princeton, New Jersey, USA (8 Jul 1974).

See CONF-740752—.

Meaningful suggestions on ways to improve the energy performance of window systems are presented. The suggestions apply to the full spectrum of technology from research and development through manufacturing, marketing, and consumer utilization. Thermal heat transfer is discussed and the results of detailed window calculations for variable window geometries, construction materials, and weather factors are given. The potential solar heat gain through architectural windows is also discussed. The presently available selective surface materials are reviewed and the problems of bonding both semiconductor and metallic films to transparent plastic materials are dealt with. The basic physics of selective infrared reflecting wide-band-gap semiconductors is discussed. (MCW)

6882 Window systems and climate control performance. *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 25, 255-285(1975).

From American Physical Society, efficient use of energy) a physics perspective; Princeton, New Jersey, USA (8 Jul 1974).

See CONF-740752—.

The significant energy transfer mechanisms through an architectural window are thermal heat transfer losses or gain, solar influx, or infiltration due to air gaps. Thermal heat transfer is discussed and the results of detailed window calculations for variable window geometries, construction materials, and weather factors are given. The variables considered individually and in combination are: variable-emissivity surfaces to reduce thermal radiation transport--these emissivities cover the full range available to doped semiconductor or metallic films; effects of multiple glazing, the effects of gap thicknesses in multiple glazing; gaps of multiple-glazed units filled with heavier-molecular-weight gases to reduce convection; and effects of wind velocity that drives the forced convection losses at the exterior window surface. An analysis of the potential solar heat gain through architectural windows is presented that considers the winter and summer seasons; the geographical localities represented by New York City, Seattle, Dallas, and Sault Ste. Marie; and various window directional orientations. The results of the study indicate that solar influx through the windows represent a very beneficial fuel-free source for auxiliary space heating. Capital costs to make windows better in conserving energy are not high. (MCW)

6883 Infrared-reflecting selective surface materials which can be useful for architectural and/or solar heat collector windows. *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 25, 286-299(1975).

From American Physical Society, efficient use of energy) a physics perspective; Princeton, New Jersey, USA (8 Jul 1974).

See CONF-740752—.

Results have shown that thermal radiation transport contributes significantly to space heating losses through architectural windows. The losses can be reduced by the use of selective surface materials deposited on the window glass and/or plastics. The "selectivity" of these materials refers to selective optical properties that are, primarily, high infrared reflectivity and high visible transmission. This review of selective surface materials deals mainly with architectural windows, but will have relevance to solar heat collector windows. A discussion of the wavelength selective properties of certain semiconductor and metallic films that show desirable properties for prospective window coatings is presented. A brief discussion follows on materials suitable for protecting a selective film from mechanical and/or chemical degradation without altering the selective optical properties. The problem of bonding selective surface materials to plastics, without altering the selective aspects of the films is discussed. The basic physics of selective infrared-reflecting doped wide-band-gap semiconductors, particularly SnO_2 and In_2O_3 when doped with certain impurities, is reviewed. (29 references) (MCW)

INDUSTRY

6884 Complementary approaches to energy conservation. *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 25, 14-24(1975).

From American Physical Society, efficient use of energy) a physics perspective; Princeton, New Jersey, USA (8 Jul 1974).

See CONF-740752—.

A review of six perspectives of complementary approaches to energy conservation is given. The six approaches that organize the subject are the choice of service and means of providing the service (task definition); the policy tools available for changing the patterns of consumption; the economic sector and the energy source or fuel; the perspective of thermodynamics (how energy is being transformed--high-temperature heat to low-temperature heat, heat to light, etc.); the stage in the chain of transformations from fuel to service; and the time period in which a given change can occur. General remarks at the end of the chapter include a chal-

lenge to the educational enterprise to include classical physics, notably areas such as fluid mechanics and classical physical and chemical thermodynamics, in academic studies. These studies are of practical importance in energy conservation. (MCW)

6885 **Sample industrial processes.** *AIP* (*Am. Inst. Phys.*) *Conf. Proc.*; No. 25, 122-151(1975).

From American Physical Society, efficient use of energy) a physics perspective; Princeton, New Jersey, USA (8 Jul 1974).

See CONF-740752—.

The use of energy in industry can be categorized by product, by quality of energy, or by the chemical/physical nature of the process. Research opportunities in electrochemical processes, physical separation of materials, and in heat transfer are discussed. Illustrations for electrochemical processes include chemical-to-electric energy conversion, solar-to-chemical conversion, and electrochemical energy storage. Desalination of seawater is used to illustrate the opportunities in separative work. Research needs in heat transfer include convection, change of phase, conduction, two-phase flow, heat transfer near the critical point, and radiation problems. (MCW)

6886 **Role of physics in combustion.** *AIP* (*Am. Inst. Phys.*) *Conf. Proc.*; No. 25, 155-159(1975).

From American Physical Society, efficient use of energy) a physics perspective; Princeton, New Jersey, USA (8 Jul 1974).

See CONF-740752—.

An attempt to identify priority physics research areas in specific energy-related engineering disciplines is presented. Three specific areas of combustion research within a broad spectrum of combustion science problems are discussed. These are the general areas of combustion diagnostics and combustion modeling, and the more specific area of emulsified fuels. (MCW)

6887 **Diagnostics for experimental combustion research.** *AIP* (*Am. Inst. Phys.*) *Conf. Proc.*; No. 25, 191-219(1975).

From American Physical Society, efficient use of energy) a physics perspective; Princeton, New Jersey, USA (8 Jul 1974).

See CONF-740752—.

Combustion diagnostics have been explored with a strong emphasis on non-perturbing optical techniques. Emphasis was placed on optical light-scattering techniques, i.e., laser Doppler velocimetry, laser Raman scattering, laser fluorescence, and particulate scattering, for two major reasons. First, these techniques address themselves to the direct measurement of the fundamental quantities in combustion science-fluid velocity, temperature, density, composition, and particulate properties. Secondly, these techniques are in an advanced stage of development in some cases and actual commercial devices in others. Other non-pertubing diagnostic techniques considered briefly included a numer of image-forming techniques that have the capability of supplying qualitative flow field information as well as quantitative, spatially correlated information for turbulent mixtures. These include holography for multi-dimensional photography of droplets and particles, radiography for diagnostics where optical windows cannot be employed, and Ramanography and coherent Raman scattering for viewing single species distributions in flow. Brief mention is made of optical and acoustic excitation. The addition of trace quantities of radioactive tracers may be the only means of in situ diagnostics in catalytic combustors and fluidized bed combustors. Four diagnostic developments are recommended. (MCW)

6888 **Energy implications of cleanup operations.** Hirst, E. (Federal Energy Administration, Washington, DC). *Environ. Sci. Technol.*; **9**: No. 1, 25-28(Jan 1975).

The conflicting aspects of the national concerns for environmental quality and energy conservation were discussed briefly. Comparisons were made of the energy conservation efficiencies of several solutions to the environmental problems of urban passenger traffic, wastewater treatment, solid waste management, air pollution abatement, and waste heat dissipation. The quantities of energy required to achieve environmental quality goals were considered relatively low. The data presented indicated that increased recycling, generation of electricity with solid waste, more widespread use of mass transit, a shift to smaller automobiles, and redesign of the internal combustion engine would both reduce pollution and conserve energy resources. (JTE)

EQUIPMENT AND PROCESSES

6889 **Modeling of combustion processes.** *AIP* (*Am. Inst. Phys.*) *Conf. Proc.*; No. 25, 160-190(1975).

From American Physical Society, efficient use of energy) a physics perspective; Princeton, New Jersey, USA (8 Jul 1974).

See CONF-740752—.

Discussions relating to the study and modeling of combustion processes have been carried out with emphasis on those aspects of combustion analysis and modeling which will benefit significantly by the input of information obtained by the application of new diagnostic techniques (e.g., laser Raman spectroscopy, laser fluorescence, and laser Doppler velocimetry) to the in situ evaluation of local properties in combustion flow fields of fundamental scientific as well as practical interest. The scope of combustion modeling is outlined. An extensive schematic is shown. Attention is focused on a few important problem areas where improvement in modeling is required. These include: elemental processes occurring in practical combustion devices; turbulent combustion; application of numerical techniques and current computer facilities to modeling of steady and nonsteady, multidimensional, turbulent combustion; and advanced or novel combustion techniques including very lean combustion, catalytic combustion, fluidized and bed combustion, and electrically and laser-augmented combustion. After some closing remarks, a bibliography containing 74 references is presented. (MCW)

6890 **Emulsified fuels.** *AIP* (*Am. Inst. Phys.*) *Conf. Proc.*; No. 25, 220-244(1975).

From American Physical Society, efficient use of energy) a physics perspective; Princeton, New Jersey, USA (8 Jul 1974).

See CONF-740752—.

Emulsified fuels, various combinations of water-in-oil, oil-in-water, or oil, water, and methanol emulsions, exhibit properties that may be effectively utilized for fire safety, for improved pipeline transmission, and for more efficient and less polluting combustion. The use of emulsified fuels in combustion systems may offer improvements in emission and performance characteristics without requiring major revision in existing technological design. This is important in view of the necessity now for industrial retooling. Topics discussed include: the fundamental properties of emulsions, particularly stability and rheology; the current methods of emulsification; the status of emulsified fuel combustion research with possible benefits in practical systems, and fundamental experimental and analytical approaches to understanding combustion characteristics of emulsions--particularly the postulated micro-explosion phenomena whereby the internal water phase vaporizes and shatters the external continuous fuel phase; societal and technical advantages of using emulsions--particularly for pipeline transportation and fire safety; and the relevant physics research areas that can impact effective utilization of emulsions. (MCW)

RECYCLING

6891 (LBL—3283) **Process development studies of the enzymatic hydrolysis of newsprint.** Wilke, C.R.; Yang, R.D. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Apr 1975. Contract W-7405-ENG-48. 37p. (CONF-750583—1). Dep. NTIS $5.00.

From 8. cellulose conference on wood chemicals-a future challenge; Syracuse, New York, USA (19 May 1975).

Background laboratory work and a tentative process for enzymatic hydrolysis of waste newsprint are described. Enzyme is produced by T. viride QM 9414 in a two stage system comprising cell growth in soluble sugars and enzyme induction on solid cellulose. Recovery of enzyme from the product sugar solution by adsorption on fresh plant feed and employment of cell recycle around the enzyme induction stages are important features of the process. Design studies indicate that it may be possible to produce sugars at a favorable cost, although additional research is needed to confirm a number of process assumptions. (auth)

ELECTRIC POWER

6892 (CONF-750867—, pp 105-114) **Short term load forecasting.** Galiana, F.D. (Univ. of Michigan, Ann Arbor). 1975.

From Proceedings on systems engineering for power; Henniker, New Hampshire, USA (17 Aug 1975).

In Systems engineering for power: status and prospects, Henniker, New Hampshire, August 17—22, 1975.

The state of the art up to the present time (June 1975) in the field of short term load forecasting in electric power systems is summarized. The prediction times considered here are of the order of minutes up to various weeks. A classification and qualitative comparison of the principal techniques in the field is made according to the type of model used, its application, the identification and model maintenance requirements, forecasting requirements, data needs, claimed accuracy, and other criteria. Some operating experiences are described, and the author's evaluation of the methods available are presented. Finally, various recommendations for further research and development in short term load forecasting are put forward. (auth)

WASTE MANAGEMENT

6893 (CNAEM-R—144) **Conversion of black water "Olive waste" to microbial protein.** Ozyurt, M. (Cekmece Nuclear Research and Training Center, Istanbul (Turkey)). Jan 1975. 54p. Dep. NTIS (US Sales Only) $5.50.

Different samples from Turkey and Italy were analyzed and subsequently the growth of microorganisms on olive waste medium, from both T and L Culture Collection and different soil samples was observed. After these initial growth observations, shake-flask fermentation experiments were carried out to assess the growth and protein value of different microorganisms. Some yeasts and molds isolated from soil were also identified with regard to their better growth and protein value obtained in this scale. These studies were followed by batch, tower, and continuous fermentation experiments. Amino acid figures were studied and also their relative protein values. It was concluded that olive waste would support the growth of a large number of microorganisms. This could be of economic benefit to the countries which are concerned with the olive oil industry, since olive waste is a by-product obtained during the olive oil process. (auth)

ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

6894 (ERDA—64) **Automotive Power Systems contractors coordination meeting, Ann Arbor, Michigan, May 6—8, 1975. Eighth summary report.** (Energy Research and Development Administration, Washington, D.C. (USA). Div. of Transportation Energy Conservation). 1975. 453p. (CONF-750568—). Dep. NTIS $10.60.

From Automotive power systems contractors coordination meeting; Ann Arbor, Michigan, USA (6 May 1975).

The presentations and discussions at the Eighth Contractors Coordination Meeting held in Ann Arbor, Michigan, May 6-8, 1975 are given. Included are presentation summaries grouped under the following broad subject areas: (1) ERDA organization, goals and plans; (2) transportation efficiency-- near-term impact programs; (3) gas turbine and related programs; (4) rankine systems; (5) stirling engine program; (6) alternative fuels program; and (7) impact studies. A separate abstract was prepared for each of the forty-one presentations for Energy Research Abstracts (ERA). (PMA)

INTERNAL COMBUSTION ENGINES

6895 **Automobile.** *AIP (Am. Inst. Phys.) Conf. Proc.*; No. 25, 99-121(1975).

From American Physical Society, efficient use of energy) a physics perspective; Princeton, New Jersey, USA (8 Jul 1974).

See CONF-740752—.

Almost all of the automobiles, trucks, motorcycles, and buses in use today are powered by either Otto-cycle or diesel-cycle internal-combustion engines. It is indicated that shifting from the present engine mix to improved diesel engines and ultimately to advanced external-combustion engines could reduce fuel consumption by one-third. The investigation begins where the engine losses occur when fuel energy is converted into transportation with the Otto-cycle engine, the single largest energy user in the transportation sector. Engine performance data are furnished for the 1969 Otto engine and data are forecast for the 1976 Otto, stratified-charge, light weight diesel, advanced gas turbine, advanced Rankine, and Stirling engines. The utilization of new devices and techniques will make possible a reasonable vehicle for the 1980s that uses less than half the fuel of present-day automobiles. (MCW)

ELECTRIC-POWERED SYSTEMS

6896 (TEC—75-006a) **Impact of future use of electric cars in the St. Louis and Philadelphia regions. Volume I. Executive summary and technical report. Final report.** Hamilton, W.F. (General Research Corp., Santa Barbara, Calif. (USA)). Sep 1975. Contract E(04-3)-1119. 109p. Dep. NTIS $5.45.

Impacts of the use of electric cars were projected for the St. Louis and Philadelphia regions in the years 1980, 1990, and 2000. As in a companion study for the Los Angeles region, the electric cars were four-passenger subcompacts using lead-acid and advanced batteries, permitting urban driving ranges of about 55 and 140 miles, respectively. Los Angeles data indicate such cars could replace some 15 to 75% of future urban autos with little sacrifice of urban driving. Adequate raw materials and nighttime recharge power should be available for such use in any single urban region. The electric cars would not save energy overall relative to future internal-combustion subcompact cars, but they could bring about major reductions in petroleum consumption where recharge power is derived from other energy sources, as it is in St. Louis and, to a lesser extent, in Philadelphia. Air quality improvements due to electric car use would be modest in importance, because conventional cars replaced will be cleaner in the future, and non-automotive sources of air pollution will be relatively more important. The electric subcompacts will be 20 to 90% more expensive overall than conventional subcompacts until battery development significantly reduces battery depreciation costs. (auth)

VEHICLE DESIGN FACTORS

ENGINE SYSTEM

6897 (ERDA—64, pp 21-24) **Improved accessory drives.** Lefferts, C. 1975.

From Automotive power systems contractors coordination meeting; Ann Arbor, Michigan, USA (6 May 1975).

In Automotive Power Systems contractors coordination meeting.

A study was made on engine and vehicle accessories normally belt driven from the engine crankshaft - cooling fan, water pump, air conditioner, alternator, and air pump (for emission control and power steering). Significant fuel economy can be obtained using a variable speed accessory drive with a much smaller speed ratio than the engine. A computer model was devised to evaluate the various trade-offs and to identify optimum combinations of accessories and vehicle operation conditions. (PMA)of 8 M urea, but can be acetylated in the presence of 6 M guanidine hydrochloride. Fully acetylated BBI has the nearultraviolet disulfide CD and the far ultraviolet polyp/eptide CD

6898 (UCRL—50025-75-4, pp 1-8) **Toward alternative transportation fuels: EE develops an onboard fuel-control research computer.** 8 Oct 1975.

In Electronics Engineering Department quarterly report No. 4, 1975.

With minor mechanical modifications (including a novel fuel tank) and an advanced closed-loop computer-controlled fuel-and-ignition-management system, currently used automobiles can be adapted to run more efficiently and with fewer emissions on non-petroleum fuels, particularly methanol. A description is given of a contribution toward demonstrating this alternative-fuel concept--an onboard fuel-control research computer. The computer is used both as a diagnostic tool and as a developmental prototype for a proposed closed-loop control system. The research computer differs from existing electronic fuel-injection units by virtue of its much greater control fexibility. For example, by simply turning a dial, a researcher can change the air/fuel ratio, even while the engine is operating. This on-the-road adjustment capability, plus the fact that the computer is easily adaptable to different engine types and sizes, makes it an extremely valuable tool for studying new tranportation fuels and their effects on the performance characteristics of entire engine families. (auth)

ALTERNATIVE FUELS

6899 (BERC/PPS—76/1) **Motor gasolines, summer 1975.** Shelton, E.M. (Energy Research and Development Administration, Bartlesville, Okla. (USA). Bartlesville Energy Research Center). Jan 1976. 74p. Dep. NTIS $4.50.

Analytical data for 3,822 samples of motor gasoline were collected from service stations throughout the country and analyzed. The samples represent the products of 57 companies, large and small, which manufacture and supply gasoline. These data are tabulated by groups according to brands (unlabeled) and grades for 17 marketing areas (districts) into which the country is divided. A map is included showing marketing areas and sampling locations. Also given are charts indicating the trends of selected properties of motor fuels since 1946 and three bar graphs illustrating the variations of octane numbers in the present survey by frequency for all samples represented. The antiknock (octane) index [(R + M)/2] averages of gasolines sold in this country were 88.0, 89.7, and 95.2 for unleaded, regular, and premium grades of gasolines, respectively. (auth)

6900 (TEC—75/001) **Motor vehicle storage of hydrogen using metal hydrides. Final report.** (Brookhaven National Lab., Upton, N.Y. (USA)). Oct 1974. 92p. Dep. NTIS $5.45.

A description is given of work and results of an experimental and analytical study of the storage of hydrogen in motor vehicles using metal hydrides. The central purpose of the work was the identification, synthesis, and evaluation of hydrides having a potential for use in automobiles on a basis comparable to present gasoline fueled vehicles. Efforts of the studies included: (1) a review and rating of known and potential hydrides; (2) the preparation of a reference design; (3) an experimental search for new hydrides; and (4) the determination of engineering properties of candidate hydrides. The experimental search for hydrides was given priority over the reference design work. Several materials were identified by the initial review as having a potential worth investigating experimentally. These were magnesium and magnesium-aluminum alloys. A number of these materials did respond to relatively simple hydriding procedures. Hydrogen uptake was encouraging, but, in the time available for the effort, none of these alloys met the desired criteria. Vehicular use was considered feasible, however. The primary output of the reference design work was a mathematical model of the behavior of two hydride storage bed concepts. Overall consideration of the effect of using hydrides with various property differences provided a guide for the identification of candidate hydrides. The utility of known and available hydrides for automotive application is indicated. (auth)

6901 (TEC—75/002) **Automotive storage of hydrogen using modified magnesium hydrides.** Rohy, D.A.; Nachman, J.F.; Duffy, T.E. (International Harvester Co., San Diego, Calif. (USA). Solar Div.). Jul 1975. Contract 68-03-2041. 56p. Dep. NTIS $5.45.

Metal hydrides can store more hydrogen per unit volume than normal high pressure or cryogenic techniques. Little energy is required to store the hydrogen in the hydride, and high stability at room temperature assures low losses over long storage periods. Safety features of metal hydride storage are favorable. Due to its low weight and high hydrogen storage densities, modified magnesium hydride offers the greatest potential for automotive storage of hydrogen. Recent experimental and analytic work was directed toward the optimization of this storage system. Due to the relative stability of MgH_2, modifications of the form MgMH/sub x/ (M = metal ion) were made to decrease the dissociation temperature while retaining high hydrogen capacity. This parameter is crucial, since vehicle exhaust will supply the thermal energy to dissociate the hydride in an automobile. System studies indicate that hydride dissociation temperature should be approximately 200°C to assure uninterrupted fuel flow at all driving and idle conditions. Experimental data developed in this study show that zinc modified Mg—Ni alloys offer the greatest potential of reaching that goal. Dissociation temperature at one atmosphere hydrogen pressure was reduced to 260°C for $Mg_{0.85}Zn_{0.05}Ni_{0.1}H$/sub x/ from 302°C for $Mg_{0.9}Ni_{.1}H$/sub x/. Nickel content was reduced to 20% from 55% in Mg_2NiH/sub x/.Dissociation pressure, hydrogen capacity, kinetics, and safety are other hydride characteristics considered. Practical considerations of cost, size, weight, fueling, and storage period of a hydride system with the energy equivalent of 20 gallons of gasoline are reviewed. (auth)

6902 (TEC—75/003) **Study of automotive storage of hydrogen using recyclable liquid chemical carriers.** Sultan, O.; Shaw, H. (Exxon Research and Engineering Co., Linden, N.J. (USA). Government Research Lab.). Jun 1975. Contract 68-02-2135. 102p. Dep. NTIS $5.45.

The catalytic dehydrogenation of naphthenes to their corresponding aromatic compounds was evaluated as a specific noncryogenic approach for the on-board recovery of hydrogen for use as an automotive fuel. The dehydrogenation of methylcyclohexane (MCH) to toluene was used in this study as representative of the contemplated storage system. Although not evaluated in detail, it was assumed that by-product toluene would be recycled to a central hydrogenation facility to regenerate the MCH. Thus, in principle, MCH would not be consumed, but would act as a hydrogen storage medium. It was concluded, based on literature information, thermodynamic and kinetic analyses, engineering considerations, and cost estimates that this method of hydrogen storage does not compare favorably with gasoline fueled automobiles. Approximately 16 times more volume of MCH than gasoline would be needed for the same mileage range, thus severely curtailing the range of an automobile with a reasonably sized MCH tank. In addition, an unreasonable amount of time (in excess of 20 minutes) would be needed to bring the dehydrogenation catalyst to operating temperature (589°K) from a cold start. Other factors that make the system appear unfavorable when compared to present automobiles are excessive system weight, high cost, and general inflexibility. No detailed comparisons were made of the MCH/hydrogenstorage system with other automotive hydrogen storage systems or other automotive propulsion systems. (auth)

MATERIALS

6903 **ADVANCES IN THERMAL CONDUCTIVITY. PRESENTED AT XIII INTERNATIONAL CONFERENCE ON THERMAL CONDUCTIVITY, LAKE OZARK, MISSOURI, NOVEMBER 5—7, 1973.** Reisbig, R.L.; Sauer, H.J. Jr. (eds.). Rolla, MO; United States of America (USA); University of Missouri (1974). 467p. (CONF-731106—).

From 13. international conference on thermal conductivity; Lake Ozark, Missouri, USA (5 Nov 1973).

Thirty-four papers are presented under the following headings: solids, gases and liquids, heterogeneous materials, experimental techniques, analytical methods, and thermal diffusivity and contact conductance. Separate abstracts were prepared for four papers, 3 for NSA and one for ERA. Six of the remaining papers were previously abstracted; see NSA 29: 12987, 26535, 28926, 29245; 30: 2366; and 31: 11992. (DLC)

6904 **MATERIALS REVIEW '75. 7TH NATIONAL SAMPE TECHNICAL CONFERENCE, ALBUQUERQUE, NEW MEXICO, OCTOBER 14—16, 1975. VOLUME 7.** Azusa, CA; United States of America (USA); Society for the Advancement of Material and Process Engineering (1975). 345p. (CONF-751005—).

From 7. national SAMPE technical conference; Albuquerque, New Mexico, USA (14 Oct 1975).

This volume and the supplement contain 45 papers on bonding, composites, adhesives, energy developments, filament winding, aging of adhesives, surface physics and chemistry, new materials, mechanical properties, heat-shrinkable materials, and sun power. Separate abstracts were prepared for 18 of the papers; 17 items are included in ERA; 2 in NSA; and 4 in SEU. (DLC)

6905 **Stress anisotropy in opposed anvil high-pressure cells.** Ruoff, A.L. (Cornell Univ., Ithaca, NY). *J. Appl. Phys.*; **46**: No. 3, 1389-1392(Mar 1975).

When materials such as sodium chloride are introduced into a piston-cylinder (or other) chamber it is commonly assumed that the state of stress for small loads is nonhydrostatic; as the load is increased, and the mean normal pressure greatly exceeds the yield stress (at zero pressure), it is commonly assumed that the state of stress approaches hydrostatic pressure. In other words it is assumed that as the mean normal pressure becomes arbitrarily large, the deviatoric stresses become negligible. It is shown that this is an erroneous assumption. Specifically it is shown that as the mean normal pressure becomes arbitrarily large, the ratios of the deviatoric stresses to the mean normal pressure approach finite values. The present analysis also shows that as the mean normal pressure is increased, the difference of pressure deduced from interplanar spacing measurements (on a cubic crystal) for planes lying normal to the piston motion to the pressure deduced from interplanar spacing measurements for planes lying parallel to the direction of piston motion, divided by the mean normal pressure, approaches a constant value. Lattice parameter measurements with the incident beam normal to the direction for piston motion underestimate the mean normal pressure, the error decreasing to a constant value as the mean normal pressure is increased. More importantly, this analysis leads to a method of measuring yield stresses as a function of pressure at high pressures using x-ray measurement of lattice spacings of planes of the appropriate orientation. (auth)

METALS AND ALLOYS

6906 (ORNL—5048) **High-temperature structural design program. Progress report for period ending December 31, 1974.** Corum, J.M.; Pugh, C.E. (Oak Ridge National Lab., Tenn. (USA)). Oct 1975. Contract W-7405-eng-26. 344p. AT.

Activities are reported concerning exploratory studies on reactor steels; constitutive equation development; materials failure; structural analysis methods and tools; inelastic structural testing and design criteria. (JRD)

PREPARATION AND FABRICATION

6907 (GEPP—172) **Cold-drawing sheet molybdenum at room temperature.** Shepherd, L.W. (General Electric Co., St. Petersburg, Fla. (USA). Neutron Devices Dept.). Nov 1975. Contract E(29-2)-656. 19p. Dep. NTIS $4.50.

When sheet molybdenum is cold-drawn and annealed, the microstructure recrystallizes, and may cause the metal to become brittle, with loss of ductility and strength. Ten to twenty percent recrystallization can occur to destroy optimum drawing quality of the metal. A recrystallization of 4 to 5 percent is ideal. It is shown that special tooling and controlled annealing can hold recrystalliza-

tion to optimum levels. Special tooling includes an automatic cycling press that closely controls the rate of draw and gives maximum pressure. A draw sleeve of high carbon steel is used. The draw sleeve can be highly polished to minimize friction and provides an intensifying effect of the ram force over the entire part. Four draw steps are used, with each step followed by an annealing at 925°C for 20 minutes. Results of recrystallization analysis show that the ideal five percent recrystallization is achieved with this process. (auth)

6908 (RDT-M—4-5T(10-75)) **Nickel—molybdenum—chromium alloy castings (ASTM A 494 with additional requirements).** (Energy Research and Development Administration, Washington, D.C. (USA). Div. of Reactor Research and Development). Oct 1975. 6p. RSO.

This standard covers Ni—Mo (15 to 18 percent)—Cr (6 to 8 percent) alloy castings for nuclear and associated applications. The additional requirements include heat treatment, composition, tension tests, weld repair, retesting, examination, quality assurance, etc. (DLC)

6909 (UNI—187) **Braze ring qualification program.** Bowles, K.C.; Tosdale, J.P. (United Nuclear Industries, Inc., Richland, Wash. (USA)). 1975. Contract AT(45-1)-1857. 5p. Dep. NTIS $3.50.

This document defines the requirements for the formal qualification of a vendor for the fabrication of braze rings, as defined in Paragraph 600 of UNI Specification HWS-8853, "Zircaloy-2 Beryllium Braze Ring Specification." (DLC)

6910 (Y-DA—6295) **Machinability aspects of diamond-turned metal optics.** Arnold, J.B.; Steger, P.J.; Morris, T.O. (Oak Ridge Y-12 Plant, Tenn. (USA)). 12 Dec 1975. Contract W-7405-eng-26. 22p. Dep. NTIS $4.50.

Work that was done to gather machinability data in order to better understand the mechanics of the diamond-turning process is described. Basic force data have been measured for the most common metals used in optical fabrication (electroplated gold, silver, OFHC copper, and 6061-T6 aluminum). In addition, force and surface deformation data were gathered on large and small-grained electroplated copper and electroplated nickel. Residual stress was measured as a function of the depth of cut in order to begin to understand how the history of the machining process could influence surface quality. (auth)

6911 (ERDA-tr—46) **Properties of NT upgraded 2 1/4Cr—1Mo weld formed material of heavy thickness.** Ujiie, A.; Sato, S.; Shimoyama, T.; Hamada, T.; Matsumota, O. Jan 1973. Translation of Japanese report. (PB—219368). 27p. Dep. NTIS $4.50.

The properties of normalized and tempered 2-$^1/_4$ Cr—1 Mo weld formed material of 200 mm thickness, fabricated under the same weld forming and heat treating conditions as those used in fabrication of reactors were investigated. It was found that the mechanical properties of weld formed material, that is, tensile properties at room and elevated temperatures, notch toughness, and creep rupture strength, satisfy the ASME requirements of NT upgraded 2-$^1/_4$ Cr—1 Mo steel and are also more homogeneous through thickness than vacuum degassed rolled plate. Notch toughness of weld formed material is similar or even better than that of rolled plate. The uniformities of the mechanical properties can be attributed to the uniform deviation of chemical composition revealed in EMX test and the smaller amount of nonmetallic inclusion and gas content. Excellent weldability of weld formed material can be beneficial to the fabrication of heavy pressure vessels without defects. (auth)

6912 **Process for electroslag refining of uranium and uranium alloys.** Lewis, P.S. Jr.; Agee, W.A.; Bullock, J.S. IV; Condon, J.B. (to U.S. Energy Research and Development Administration). US Patent 3,895,935. 22 Jul 1975. Filed date 16 Dec 1974. 6p.

PAT-APPL-533,111.

A process is described for electroslag refining of uranium and uranium alloys wherein molten uranium and uranium alloys are melted in a molten layer of a fluoride slag containing up to about 8 weight percent calcium metal. The calcium metal reduces oxides in the uranium and uranium alloys to provide them with an oxygen content of less than 100 parts per million. (auth)

6913 **Weldable, age hardenable, austenitic stainless steel.** Brooks, J.A.; Krenzer, R.W. (to U.S. Energy Research and Development Administration). US Patent 3,895,939. 22 Jul 1975. Filed date 31 Oct 1973. 10p.

PAT-APPL-411,554.

An age hardenable, austenitic stainless steel having superior weldability properties as well as resistance to degradation of properties in a hydrogen atmosphere is described. It has a composition of from about 24.0 to about 34.0 weight percent (w/o) nickel, from about 13.5 to about 16.0 w/o chromium, from about 1.9 to about 2.3 w/o titanium, from about 1.0 to about 1.5 w/o molybdenum, from about 0.01 to about 0.05 w/o carbon, from about 0 to about 0.25 w/o manganese, from about 0 to about 0.01 w/o phosphorous and preferably about 0.005 w/o maximum, from about 0 to about 0.010 w/o sulfur and preferably about 0.005 w/o maximum, from about 0 to about 0.25 w/o silicon, from about 0.1 to about 0.35 w/o aluminum, from about 0.10 to about 0.50 w/o vanadium, from about 0 to about 0.0015 w/o boron, and the balance essentially iron. (auth)

6914 **Displaced electrode process for welding.** Heichel, L.J. (to U.S. Energy Research and Development Administration). US Patent 3,902,038. 26 Aug 1975. Filed date 22 Jul 1974. 4p.

PAT-APPL-490,446.

A method is described for the butt-welding of a relatively heavy mass to a relatively small mass such as a thin-wall tube. In butt-welding heat is normally applied at the joint between the two pieces which are butt-welded together. The application of heat at the joint results in overheating the tube which causes thinning of the tube walls and porosity in the tube material. This is eliminated by displacing the welding electrode away from the seam toward the heavier mass so that heat is applied to the heavy mass and not at the butt seam. Examples of the parameters used in welding fuel rods are given. The cladding and end plugs were made of Zircalloy. The electrode used was of 2 percent thoriated tungsten. (auth)

6915 **Sintered cobalt-rare earth intermetallic product.** Benz, M.G. (to General Electric Co.). US Patent 3,919,003. 11 Nov 1975. Filed date 11 Feb 1974. 10p.

This patent describes a sintered product having substantially stable permanent magnet properties in air at room temperature. It comprises compacted particulate cobalt—rare earth alloy consisting essentially of a Co_5R intermetallic phase and a CoR intermetallic phase which is richer in rare earth metal content than the Co_5R phase, where R is a rare earth metal. The Co_5R intermetallic phase is present in an amount of at least 65 percent by weight of the sintered product and the CoR intermetallic phase which is richer in rare earth metal content than the Co_5R phase is present in a positive amount having a value ranging up to about 35 percent by weight of the product. The sintered product has a density of at least 87 percent and has pores which are substantially noninterconnecting and wherein the component grains have an average size less than 30 microns. (Official Gazette)

6916 **Sintered cobalt-rare earth intermetallic product.** Benz, M.C. (to General Electric Co.). US Patent 3,919,002. 11 Nov 1975. Filed date 11 Feb 1974. 10p.

A process is described for preparing novel sintered cobalt—rare earth intermetallic products which can be magnetized to form permanent magnets having stable improved magnetic properties. A cobalt—rare earth metal alloy is formed having a composition which at sintering temperature falls outside the composition covered by the single Co_5R intermetallic phase on the rare earth richer side. The alloy contains a major amount of the Co_5R intermetallic phase and a second solid CoR phase which is richer in rare earth metal content than the Co_5R phase. The specific cobalt and rare earth metal content of the alloy is substantially the same as that desired in the sintered product. The alloy, in particulate form, is pressed into compacts and sintered to the desired density. The sintered product is comprised of a major amount of the Co_5R solid intermetallic phase and up to about 35 percent of the product of the second solid CoR intermetallic phase which is richer in rare earth metal content than the Co_5R phase. (Official Gazette)

6917 **Liquid sintered cobalt-rare earth intermetallic product.** Benz, M.G. (to General Electric Co.). US Patent 3,919,004. 11 Nov 1975. Filed date 15 Feb 1974. 14p.

A process is described for preparing novel sintered cobalt—rare earth intermetallic products which can be magnetized to form permanent magnets having stable improved magnetic properties. A particulate mixture is formed of a base CoR alloy and an additive CoR alloy, where R is a rare earth metal. The base CoR alloy is one which, at sintering temperature, exists as a solid Co_5R intermetallic single phase. The additive CoR alloy is richer in rare earth metal than the base CoR alloy, and at sintering temperature is at least partly liquid. The base and additive alloys, in particulate form, are each used in an amount to form a mixture which has a cobalt and rare earth metal content substantially corresponding to that of the final desired sintered product. The mixture is pressed into compacts and sintered to the desired sintered product phase composition and density. At sintering temperature, the final sintered product has a phase composition lying outside the Co_5R single phase on the rare earth richer side. Specifically, the final sintered product contains a major amount of the Co_5R solid inter-

metallic phase and up to about 35 percent of the product of a second solid CoR intermetallic phase which is richer in rare earth content than the Co_5R phase. (auth)

STRUCTURE AND PHASE STUDIES

6918 (LBL—4105) **Oxygen stabilized rare-earth iron intermetallic compounds.** Dariel, M.P.; Malekzadeh, M.; Pickus, M.R. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1975. Contract W-7405-ENG-48. 10p. (CONF-751209—20). Dep. NTIS $3.50.

From 21. annual conference on magnetism and magnetic materials; Philadelphia, Pennsylvania, USA (9 Dec 1975).

A new, oxygen-stabilized intermetallic compound was identified in sintered, pre-alloyed rare-earth iron powder samples. Its composition corresponds to formula $R_{12}Fe_{23}O_2$ and its crystal structure belongs to space group Im3m. The presence of these compounds was observed, so far, in several R—Fe—O systems, with R = Gd, Tb, Dy, Ho, Er, and Y. (auth)

6919 (ORNL-tr—4046) **Experimental study of the Nernst—Einstein relation: electrotransport in FeO.** Morin, F.; Beranger, G.; Lacombe, P. Translated by M. Gerrard from *Rev. Int. Hautes Temp. Refract.*; **10**: 91-101(1973). 20p. Dep. NTIS $4.50.

Results of direct measurement of electro transport in FeO are reported. It was found that iron protooxide can undergo high temperatures and current intensities going up to 90 A/cm², for very long times without polarization being manifested or the conductivity being changed. The transport number measured by means of electro transport tests is greater than that calculated from a defect with charge Z/sub i/ = 3 and even more so with Z/sub i/ = 2 if it is assumed that this defect diffuses by a vacancy mechanism. These results are discussed in terms of the correlation factor. By an elementary discussion of the possible diffusion mechanisms relative to the experimental results, the preponderance of diffusion of Fe^{3+} ions is shown. A more important correlation effect than that considered for a vacancy mechanism is one which indicates the intervention of secondary diffusion mechanisms, themselves attributable to the proximity of the defects. By micrographic study, it is shown that pore formation in the electrolytic deposit is a limited and accidental phenomenon which can be completely eliminated if the initial oxide-iron contact is perfect. (auth)

6920 **LaNi/sub 5-x/Pt/sub x/: NMR investigation of structural and electronic properties.** Weisman, I.D. (National Bureau of Standards, Gaithersburg, MD); Bennett, L.H.; McAlister, A.J.; Watson, R.E. *Phys. Rev., B;* **11**: No. 1, 82-91(1 Jan 1975).

Pt-site Knight shifts kappa, relaxation times, and crystallographic data were obtained for the LaNi/sub 5-x/Pt/sub x/ (0 less than or equal to x less than or equal to 5) system. There are two transition-metal sites: one, A, in a La layer and one, B, between La layers; different kappa's are observed for each site. The system is found to be completely miscible and NMR intensities and crystallographic results show that Pt prefers the B site and that considerable ordering occurs for x less than or equal to 4. The ^{195}Pt kappa's are approximately 1 percent and approximately 0 percent for the A and B sites, respectively, in $LaPt_5$; the A-site kappa is approximately 0 at $LaNi_5Pt$ and the B-site kappa reaches -2 percent in $LaNi_{4.75}Pt_{0.25}$. The shifts, taken together with relaxation times, indicate that s-band effects dominate, particularly for the A site, in $LaPt_5$ and that the Pt atoms on both sites become more transition-metal-like with increasing x. Exchange enhancement is shown to be an essential factor at the Ni-rich end. Variations in chemical activity, as in hydride formation, are discussed in light of these electronic differences between $LaNi_5$ and $LaPt_5$. (auth)

6921 **Surface characterization by single-atom mass spectroscopy.** Panitz, J.A. (Sandia Labs., Albuquerque, NM). *CRC Crit. Rev. Solid State Sci.;* **5**: No. 2, 153-178(Sep 1975).

The technology of single-atom mass spectroscopy is reviewed. Information is included on atom-probe field-ion microscopes, time-of-flight atom-probes, mass resolution of time-of-flight atom probes, aiming atom probes, single-ion detection, magnetic atom-probes, 10-cm atom-probes and field-desorption microscopy. (JRD)

6922 **High resolution study of ordering reactions in gold—chromium alloys.** Dutkiewicz, J.; Thomas, G. (Univ. of California, Berkeley). *Metall. Trans., A;* **6A**: No. 10, 1919-1928(Oct 1975).

The ordering reactions in Au_4Cr and Au_3Cr alloys have been investigated using high resolution dark field and lattice imaging techniques. In all cases the ordered structures can be described in terms of compositional modulations as occur during spinodal decomposition. In alloys quenched from above the critical temperature sro microdomains of size 10 to 15A have been resolved with structures represented by modulations in composition along [420]. After aging the Au_4Cr alloy below T/sub c/ the D1a lro phase appears as ordered domains of size 50 to 100A showing composition modulations with wavelength of 5d(531). These domains grow in size up to 500A becoming finally the D1a fully ordered structure. A new observation has been made in the Au_3Cr alloy, viz., that the lro structure is nonstoichiometric $L1_0$ with λ/sub [001] = 4A. The transformation from sro in this alloy occurs with the formation of a transitional ordered phase, (similar to DO_{22}), which can be described in terms of composition modulations along [001], with wavelength equal to the c parameter (8A) of the DO_{22} structure. Lattice imaging of the two variants of superlattice planes in ordered Au_4Cr enabled the atomic arrangement in the area of translational and rotational antiphase boundaries to be determined. (auth)

6923 **Discussion of mathematical representation of thermodynamic properties of binary systems and solution of Gibbs—Duhem equation.** Williams, R.O. (Oak Ridge National Lab., TN). *Metall. Trans., A;* **6A**: No. 10, 1962-1963(Oct 1975).

The conclusion that orthogonal series is an advantageous method of representing the thermodynamics of binary solutions is examined. It is noted that at least three terms are normally required in representations but seldom more than five. The inclusion of supplementary conditions to control the smoothness would only increase the number by one or two. (JRD)

6924 **de Haas—van Alphen effect and the band structure of URh_3.** Arko, A.J.; Brodsky, M.B.; Crabtree, G.W.; Karim, D.; Koelling, D.D.; Windmiller, L.R.; Ketterson, J.B. (Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev., B;* **12**: No. 10, 4102-4112(15 Nov 1975).

Measurements were made of the de Haas—van Alphen (dHvA) effect in the intermetallic compound URh_3, a material with a partially filled 5f shell. Complex dHvA spectra containing several frequencies were observed and Fourier analyzed with an on-line computer. Effective-mass measurements were made for several orbits and values as large as 5.3 were observed. Much of the data are consistent with a multiply connected surface whose shape is discussed. In addition to the dHvA experiments, a detailed band-structure calculation was performed using the nonflat relativistic-augmented-plane-wave formalism. The Fermi surface deduced from these calculations is in qualitative agreement with the experimental observation. (AIP)

MECHANICAL PROPERTIES

6925 (BMI—1939) **Critical experiments, measurements and analyses to establish a crack arrest methodology for nuclear pressure vessel steels. Fourth quarterly progress report, Task 62.** Hahn, G.T.; Gehlen, P.C.; Hoagland, R.G.; Kanninen, M.F.; Popelar, C.; Rosenfield, A.R. (Battelle Columbus Labs., Ohio (USA)). Nov 1975. Contract W-7405-eng-92. vp. Dep. NTIS $5.45.

A two-dimensional, finite-difference, dynamic analysis of crack propagation and arrest is developed. The analysis has been applied to the wedge-loaded rectangular DCB specimen. Preliminary results of the two-dimensional analysis, particularly the crack velocity-arrest length relation, are very similar to those previously obtained with the one-dimensional treatment. Two critical tests of the dynamic/energy conservation analysis of crack arrest were performed. Measurements of crack propagation and arrest in Homalite-100 performed at the University of Washington have been compared with one-dimensional calculations employing the K/sub D/-velocity dependence of this material measured independently at the University of Maryland. The calculation results are in good accord with the measurements of crack speed, arrest length, and the local stress intensity. In addition, measurements of crack propagation and arrest in wedge- and machine-loaded, contoured DCB specimens of AISI 4340 are compared with calculation results using the K/sub D/(V) previously derived from wedge-loaded rectangular DCB-test pieces. Results of these experiments support the view that K/sub D/(V) is geometry and loading independent. Efforts to develop a testing procedure were centered on the LEFM size requirements for rectangular-DCB test pieces. (auth)

6926 (CONF-751144—1) **Crack growth and CREEP-fatigue interaction behavior of 2 1/4 Cr—1 Mo steel.** Brinkman, C.R. (Oak Ridge National Lab., Tenn. (USA)). 1975. 20p. Dep. NTIS $4.50.

From Nuclear regulatory commission information meeting; Germantown, Maryland, USA (11 Nov 1975).

Cyclic strain-controlled fatigue tests and cyclic tension-tension crack growth tests employing precracked specimens are being conducted at RT to 593°C in various environments including air, steam, vacuum, and impure He. Fatigue and creep-fatigue data at 482 and 538°C, effects of temperature, waveform, and hold time or strain rate of fatigue life; comparisons with linear damage rule; subcritical crack growth tests; effects of variation of min to max

load ratio; and effects of environment (air, steam, He) on crack growth are given. 15 figures. (DLC)

6927 (COO—1676-39) **Dislocation-solute atom interactions in alloys. Technical progress report, February 1, 1975—January 31, 1976.** Gibala, R.; Sethi, V.K.; Fournier, R. (Case Western Reserve Univ., Cleveland, Ohio (USA). Dept. of Metallurgy and Materials Science). 31 Oct 1975. Contract AT(11-1)-1676. 27p. Dep. NTIS $5.00.

New results were obtained in two major project areas: (1) surface oxide softening and solute gradients in niobium and tantalum, and (2) mechanical properties of Nb—H and Nb—D alloys. The important results include: (a) observation and characterization of an extremely large softening and ductilizing effect of bcc metals (niobium and tantalum) by application of thin (500 to 1000 A) oxide films coupled with injection of a high density of mobile dislocations; (b) determination of the relative strengthening ductility changes caused by hydrogen and deuterium in niobium. (auth)

6928 (COO—2204-14) **Correlation of mechanical and metallurgical parameters with the acoustic emission during tensile deformation of several metals and alloys.** Hartman, W.F. (Johns Hopkins Univ., Baltimore, Md. (USA)). Dec 1975. Contract AT(11-1)-2204. 15p. Dep. NTIS $3.50.

Acoustic emission was monitored during plastic deformation under dead-weight tensile loading of polycrystalline aluminum, brass, copper, and steel. The acoustic emission data, both threshold-type and frequency-analysis type, were correlated with yield strength, stored elastic energy, strain hardening parameters, loading histories, diffusion processes, slip band motion and mosaic cell size. Major results are presented under the headings discontinuous yielding (Portevin—Le Chatelier Effect), parabolic strain hardening, and frequency analysis. The principal experimental techniques are also summarized. (auth)

6929 (EUR—5343e) **Investigation on the release of stored energy from polycrystalline copper deformed at room-temperature by torsion.** Lang, E. (Commission of the European Communities, Petten (Netherlands). Joint Nuclear Research Center). 1975. 28p. Dep. NTIS (US Sales Only) $5.00.

Recrystallization of 5N copper samples which had been deformed at room temperature by torsion to an average shear of $\gamma = 1.75$ was investigated by means of a heatflow calorimeter. During the recrystallization process which was also studied by hardness tests and optical microscopy, a stored energy of 0.15 cal/g was released. By kinetic analysis based on the variation of the linear heating rate, a value of 0.95 eV was determined for the activation energy of the recrystallization. (auth)

6930 (ORNL—5086) **Use of instrumented charpy tests to determine onset of upper-shelf energy.** Canonico, D.A.; Stelzman, W.J.; Berggren, R.G.; Nanstad, R.K. (Oak Ridge National Lab., Tenn. (USA)). Nov 1975. Contract W-7405-eng-26. 18p. Dep. NTIS $4.00.

The Charpy V-notch (C/sub v/) upper-shelf energy is usually defined as that temperature range in which the surface of the C/sub v/ specimen exhibits an appearance indicative of a 100 percent ductile fracture. In an attempt to avoid the need for interpretation, the selection of the C/sub v/ upper-shelf energy is based on the results from an instrumented impact test which provides a permanent record of the load-deflection history of a C/sub v/ specimen during the testing sequence. In the brittle-ductile transition temperature regime, a precipitous drop in the load trace occurs. The amount of the drop decreases at higher temperatures until it is zero, and the zero-drop-in-load temperature is identical to the onset of the C/sub v/ upper shelf. This relationship between the drop in load and energy in an instrumented impact test provides incontestable assurance that the C/sub v/ upper shelf has been obtained. This relationship between drop in load and temperature permits a prediction of the onset of the upper-shelf temperature with as few as two instrumented impact tests. It is also shown that nil-ductility temperature (NDT) (determined by the drop-weight test) is released to the C/sub v/ upper shelf. For the SA-508 Class 2 and SA-533 Grade B Class 1 steels employed in the fabrication of pressure vessels for light-water reactors, C/sub v/ testing at NDT + 180°F (100°C) will provide upper-shelf energy values. (DLC)

6931 (ORNL-TM—5028) **High-strain-rate tensile properties of annealed 2 1/4 Cr—1 Mo steel.** Klueh, R.L.; Oakes, R.E. Jr. (Oak Ridge National Lab., Tenn. (USA)). Oct 1975. Contract W-7405-eng-26. 18p. AT.

The high-strain-rate tensile properties of annealed $2^1/_4$ Cr—1 Mo steel were determined and the tensile behavior from 25 to 566°C and strain rates of 2.67×10^{-6} to 144/s are described. Above 0.1/s at 25°C, both the yield stress and the ultimate tensile strength increased rapidly with increasing strain rate. As the temperature was increased, a dynamic strain aging peak appeared in the ultimate tensile strength-temperature curves. The peak height was a maximum at about 350°C and 2.67×10^{-4}/s. With increasing strain rate, a peak of decreased height occurred at progressively higher temperatures. The major effect of strain rate on ductility occurred at elevated temperatures, where a decrease in strain rate caused an increase in total elongation and reduction of area. (auth)

6932 (ORNL-TM—5192) **Residual cold work and its influence on tensile and creep properties of types 304 and 316 stainless steel.** Sikka, V.K.; Swindeman, R.W.; Brinkman, C.R.; Booker, M.K. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 26p. AT.

Tensile and creep properties of types 304 and 316 stainless steel in the as-received (mill-annealed) and reannealed (laboratory-annealed) conditions were related by P/sub RA/ = A + BP/sub AR/, where P/sub RA/ and P/sub AR/ are properties in reannealed and as-received conditions, respectively, and A and B are material constants. Constant B was shown to give a measure of change in tensile properties due to grain size differences, whereas A, although related to grain size, primarily gave a measure of cold work. The mill-annealed condition of plate and pipe products of types 304 and 316 stainless steel showed 3 to 4 percent residual cold work presumably resulting from bending and straightening operations, as opposed to approximately 10 percent for the bar product of type 316 stainless steel. The changes in creep properties on reannealing were shown to be consistent with corresponding changes observed in yield strength and grain sizes. Constants A and B are summarized for tensile and creep properties of plate, pipe, and bar products of types 304 and 316 stainless steel. 12 figures. (auth)

6933 **Reinforced superconductors for CTR (Tokamak) magnet.** Moss, M.; Gerstle, F.P. Jr. (Sandia Labs., Albuquerque, NM). pp 10-15 of In Materials review '75. Azusa, CA; Society for the Advancement of Material and Process Engineering (1975).

From 7. national SAMPE technical conference; Albuquerque, New Mexico, USA (14 Oct 1975).

See CONF-751005—(Suppl.).

Superconducting wire composed of Nb—Ti filaments in a copper stabilizing matrix (1:1.25 by volume) was mechanically reinforced with diffusion-bonded Borsic-Al tape brazed to the copper. The elastic modulus and tensile strength of the composite are higher than those of the superconducting wire alone enabling it to better withstand the high stresses in the magnet winding of a Tokamak thermonuclear reactor. (auth)

6934 (UCRL-Trans—10976) **Formation of zones of increased ductility in a uranium alloy with 0.2% by weight of vanadium fractured by tension under hydrostatic pressure.** Auger, J.P. Translated from *C. R. Hebd. Seances Acad. Sci., Ser. C;* **281**: No. 2/3, 95-98(21 Jul 1975). 8p. Dep. NTIS $4.50.

The fracture mechanism of various states of the alloy U—V 0.2 percent is modified by the application of a hydrostatic pressure during the tensile test. In particular, zones appear in which the metal is very elongated. The fractographic appearance of these zones is described. A deformation and breaking model is proposed. (auth)

6935 **Particle size influence on the strength relation for air sintered aluminum.** German, R.M. (Sandia Labs., Livermore, CA). *Metall. Trans., A;* **6A**: No. 10, 1964-1965(Oct 1975).

A new strength relation with respect to an alternative processing schedule and varying Al particle size is evaluated. It is concluded that the strength relation is a strength-density expression. The applicability of this model to alternative processing schedules is demonstrated and the influence of particle size is shown to be extensive. An equation is given which allows delineation of the strength-compaction pressure relation with minimal experimentation. Designing components requiring simultaneous strength and porosity is thereby facilitated by its use. (JRD)

6936 **Mechanical properties of plasma-sprayed 1100 aluminum as a composite matrix.** Ericksen, R.H.; Swearengen, J.C.; Allred, R.E. (Union Carbide Materials Systems Div., Indianapolis). *SAMPE Q.;* **7**: No. 1, 1-8(Oct 1975).

The mechanical properties of an aluminum alloy prepared by plasma spraying and hot pressing commercially pure aluminum powder have been determined. The structure and composition of the material was representative of conditions likely to be found in popular aluminum-matrix composites. The yield and ultimate strengths of the material fall between those of wrought 1100 aluminum and sintered aluminum powder (SAP) of similar oxide content. Measurement of Poisson strains in directions parallel and perpendicular to the direction of hot pressing showed that the material was plastically, but not elastically, anisotropic. The strain-rate

sensitivity of the plasma sprayed aluminum was similar to that of commercial 1100 aluminum. These results provide additional insights for fabrication of composites from this matrix system, and for interpreting or predicting the mechanical properties of those composites. (auth)

6937 Influence of subgrain boundaries on the rate controlling creep processes in Fe—3 pct Si. Stang, R.G. (Univ. of Washington, Seattle); Nix, W.D.; Barrett, C.R. *Metall. Trans., A;* 6A: No. 11, 2065-2071(Nov 1975).

The influence of subgrain boundaries on the kinetics of high temperature creep is studied by comparing the creep properties of textured Fe-3 percent Si with the properties of randomly oriented polycrystalline samples of the same composition. The steady state creep properties of the two materials are very nearly the same even though the randomly oriented polycrystalline samples exhibit subgrain formation while the textured samples do not. The transient creep properties of these materials are widely different indicating that the presence of subgrain structure can affect the transient creep behavior without affecting the steady state properties. Long creep delays produced by stress reductions during creep are associated with the presence of subgrain boundaries. The textured samples which have no subgrains do not show these transients. It is suggested that the creep transients for the randomly oriented polycrystalline samples are more sluggish than those for the textured samples because recovery involving subgrain boundary movement is slower than that for homogeneous dislocation rearrangement. (auth)

PHYSICAL PROPERTIES

6938 (CONF-751212—3) **Mode softening and high superconducting transition temperature in some A-15 compounds.** Knapp, G.S.; Bader, S.D.; Fisk, Z. (Argonne National Lab., Ill. (USA); California Univ., San Diego (USA)). 1975. 7p. Dep. NTIS $4.50.

From International conference on low lying lattice vibrational models and their relationship to superconductivity and ferroelectricity; San Juan, Puerto Rico (1 Dec 1975).

The electronic density of states at the Fermi level, N(E/sub F/), and the geometric mean phonon frequencies, ω/sub g/, were determined from heat-capacity data for a number of A-15 superconductors. Although ω/sub g/ is an appropriate average phonon parameter for evaluating McMillan's expression for lambda, it was found that the T/sub c/ values cannot be reliably estimated using ω/sub g/. There are, however, strong correlations between lambda, N(E/sub F/), and the temperature dependence of ω/sub g/, dlnω/sub g/dT. The high-T/sub c/, high-N(E/sub F/) materials V_3Si and V_3Ga show the largest phonon-mode softening on cooling. It is proposed that, for the higher-N(E/sub F/) materials, particular phonon-modes strongly couple to the electronic system and enhance T/sub c/ to a greater extent than average phonon properties would indicate. (auth)

6939 (CONF-751212—4) **Effect of sharp structure in the electronic density of states on the electron—photon coupling in high T/sub c/ superconductors.** Fradin, F.Y. (Argonne National Lab., Ill. (USA)). 1975. Contract W-31-109-Eng-38. 7p. Dep. NTIS $4.50.

From International conference on low lying lattice vibrational models and their relationship to superconductivity and ferroelectricity; San Juan, Puerto Rico (1 Dec 1975).

The evidence for sharp structure in the electronic density of states N(epsilon) of certain classes of high T/sub c/ superconductors is based on the normal state temperature dependence of the spin susceptibility chi, electronic specific-heat coefficient γ, electrical resistivity rho, and nuclear spin-lattice relaxation rate $1/T_1$. Model calculations of chi, γ, rho, and T_1 in the rigid N(epsilon) approximation and of chi and γ for a temperature dependent N(epsilon) are presented for V_3Ga and V_3Si. The model calculations were used to calculate the explicit temperature dependence of the electron mass enhancement and the renormalized electronic specific heat coefficient. The temperature dependence of the dielectric screening, which can have an important effect on renormalizing the phonon frequencies at low temperatures, is also discussed. (auth)

6940 (COO—3150-37) **Comments on RFSE in cylinders.** Baer, D.R. (Cornell Univ., Ithaca, N.Y. (USA). Lab. of Atomic and Solid State Physics). Oct 1975. Contract AT(11-1)-3150. 11p. Dep. NTIS $4.50.

Field and angle derivatives of the surface impedance have been measured for tungsten and potassium cylinders. Several observations are presented. (auth)

6941 (IS-M—55) **Kondo effect in Y-rich alloys containing a Ce impurity.** Petersen, T.S.; Legvold, S.; Burgardt, P. (Ames Lab., Iowa (USA); Iowa State Univ. of Science and Technology, Ames (USA). Dept. of Physics). 1975 14p. (CONF-751209—12). Dep. NTIS $4.50.

From 21. annual conference on magnetism and magnetic materials; Philadelphia, Pennsylvania, USA (9 Dec 1975).

Sugawara et al. have found that Ce impurities in some nonmagnetic rare earth hosts exhibit the Kondo effect. Maple and Wittig have shown that when pressure is applied to Y—Ce, the Kondo effect disappears, assumedly because the 4f level is driven from below to above the Fermi level. In the work reported here, alloy hosts of Y/sub x/La/sub 1-x/ are used to get the slope of the Kondo resistivity as a function of atomic volume for samples containing 2 atomic percent Ce impurity. The slope of the rho vs ln T, (drho/d lnT) varies markedly with atomic volume and shows a sharp peak near x = 0.95. Furthermore, by using Y—Lu host alloys the Kondo effect will disappear at the atomic volume calculated for the Maple and Wittig result. (auth)

6942 (IS-M—56) **Magnetic moments of ferromagnetic gadolinium alloys.** White, H.W.; Beaudry, B.J.; Burgardt, P.; Legvold, S.; Harmon, B.N. (Ames Lab., Iowa (USA); Iowa State Univ. of Science and Technology, Ames (USA). Dept. of Physics). 1975. 7p. (CONF-751209—69). Dep. NTIS $4.50.

From 21. annual conference on magnetism and magnetic materials; Philadelphia, Pennsylvania, USA (9 Dec 1975).

Saturation magnetization and lattice parameter measurements have been made on samples of polycrystalline and single crystal c-axis gadolinium and on samples of polycrystalline gadolinium alloyed with scandium, yttrium, lutetium, lanthanum, magnesium, ytterbium and thorium. The magnetic measurements were made near 4.2°K in fields up to 30 kOe. Alloy concentrations ranged up to 30 atomic percent. For pure single crystal gadolinium the saturation moment was measured to be 7.63 +- .01μ/sub B/ per gadolinium atom. This result indicates the conduction electron contribution is about 13 percent higher than the value obtained from earlier measurements. For polycrystalline gadolinium the saturation moment per atom was found to be 7.555 +- .015μ/sub B/. The excess moment per Gd atom for the polycrystalline alloys fell near a straight line when plotted as a function of the unit cell axes ratio c/a. The c/a ratios ranged from 1.583 to 1.595 and the excess moments were between 0.78 and 0.44μ/sub B/. There was no correlation of excess moment with atomic volume or with the valence of the solute atoms. (auth)

6943 (LBL—4109) **1/f noise: diffusive systems and music.** Voss, R.F. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1975. Contract W-7405-Eng-48. 114p. Dep. NTIS $5.50.

Thesis.

Measurements of the 1/f voltage noise in continuous metal films are reported. At room temperature, samples of pure metals and bismuth (with a carrier density smaller by 10^8) of similar volume had comparable noise. The results suggest that the noise arises from equilibrium temperature fluctuations modulating the resistance. Spatial correlation of the noise implied that the fluctuations obey a diffusion equation. The empirical inclusion of an explicit 1/f region and appropriate normalization lead to excellent agreement with the measured noise. If the fluctuations are assumed to be spatially correlated, the diffusion equation can yield an extended 1/f region in the power spectrum. The temperature response of a sample to delta and step function power inputs is shown to have the same shape as the autocorrelation function for uncorrelated and correlated temperature fluctuations, respectively. The spectrum obtained from the cosine transform of the measured step function response is in excellent agreement with the measured 1/f voltage noise spectrum. Spatially correlated equilibrium temperature fluctuations are not the dominant source of 1/f noise in semiconductors and metal films. However, the agreement between the low-frequency spectrum of fluctuations in the mean-square Johnson noise voltage and the resistance fluctuation spectrum measured in the presence of a current demonstrates that in these systems the 1/f noise is also due to equilibrium resistance fluctuations. Loudness fluctuations in music and speech and pitch fluctuations in music also show the 1/f behavior. 1/f noise sources, consequently, are demonstrated to be the natural choice for stochastic composition. 26 figures, 1 table. (auth)

6944 (UCID—16956) **Thermophysical measurements on metals up to 0.4 GPa and 8000K.** Shaner, J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Nov 1975. Contract W-7405-ENG-48. 16p. Dep. NTIS $4.50.

Experimental techniques for thermophysical measurements on liquid metals in the 0.4 GPa and 8000°K range are described. Examples of the kind of data obtained for tantalum are presented. (auth)

6945 (UCRL—51244(Rev.1)) **Literature study of metallic ternary and quanternary hydrides.** Newkirk, H.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Sep 1975. Contract W-7405-Eng-48. 33p. Dep. NTIS $4.00.

Metallic hydrides are being considered as an attractive solution to storage problems involved in using hydrogen as an alternative fuel. In this application, the unclassified literature was surveyed to find metallic ternary hydride systems of the type MM'H/sub x/; M is a transition element, a member of the rare earth element series, or a member of the actinide element series, and M' is a transition element. Reported quaternary hydrides of the same metallic element series were also reviewed. The hydride-forming systems found and some of their most interesting properties are summarized. Recent advances in the understanding of the absorption characteristics and the stability of these hydride materials are reviewed. (auth)

6946 (RFP-Trans—174) **Investigations of interactions between mechanically stressed metal surfaces and gases by means of radioactive labelling .** Schober, E. Translated from *Schmierungstechnik;* **2**: No. 9, 282-283(1971). 3p. Dep. NTIS $4.50.

Tribosorption processes in copper/carbon dioxide, copper/krypton, and gold/carbon dioxide systems were investigated. It was found that changes in the physicochemical properties of mechanically stressed metals are caused by frictionally adsorbed gases, surface area increases, production of fresh surfaces, and creation of energetically and morphologically well-defined states. (JRD)

6947 (UCRL-Trans—10734) **Phase transformations in uranium—vanadium alloys: influence of the carbon content.** Collot, C.; Couterne, A.; Guillaume, C.; Giraud-Heraud, F.; Guillaumin, J. Translated from *J. Nucl. Mater.;* **43**: 28-50(1972). 40p. Dep. NTIS $5.00.

Results of a study of the refinement of U—V alloys with low V contents (from 0.1 to 1 percent) are presented. The kinetics of the U/sub beta/ yields U/sub alpha/ transformation, which determines the size of the α grains, are very sensitive to the carbon content. Microdiffraction analysis of the precipitates formed in these alloys on cooling gives evidence of a V—C type of interaction in the solid phase, the characteristics of which are given. The transformation curves, which were obtained for different V and C contents, show that the latter element can not only deplete the β matrix in V through the formation of carbides V_2C or with a formula intermediate between V_2C and VC, but can also affect the intrinsic stability of the (U,V)/sub beta/ solution. The refinement of the α grain in the U—V alloys is controlled by a set of parameters, each of which has a more or less important influence. These are in particular: the V content—the C content, but not through the effect of carbide particles on the heterogeneous germination of the α phase—the solidification rate, which mainly determines the size of the γ grain, then that of the β grain, i.e. the kinetics of the U/sub beta/ yields U/sub alpha/ reaction. (auth)

6948 **Molecular orbital investigation of chemisorption. II. Nitrogen on tungsten (100) surface.** Anders, L.W. (Ames Lab., IA); Hansen, R.S.; Bartell, L.S. *J. Chem. Phys.;* **62**: No. 5, 1641-1654(1 Mar 1975).

The relative bonding energies of nitrogen chemisorbed at three symmetric sites on a W(100)surface, represented by finite arrays of tungsten atoms [L. W. Anders, R. S. Hansen, and L. S. Bartell, J. Chem. Phys. 59, 5277 (1973)] were obtained by means of the extended Huckel molecular orbital theory (EHMO). The preferred site for nitrogen chemisorption was found to be the five coordination number (5 CN) site or the fourfold site with a tungsten atom below four tungsten atoms surrounding the nitrogen atom. The 5p orbital repulsive energy, in the case of hydrogen chemisorption, could be adequately approximated by the sum over pairs of empirical exponential repulsive terms; in the case of nitrogen chemisorption, this same method was approximately 10% in error at the equilibrium bond distance, and repulsive energies were therefore obtained from calculations including tungsten 5p orbitals but with smaller arrays. (auth)

6949 **Mechanisms of flux line lattice motion in a peak effect superconductor.** Lauterwasser, B.D.; Kramer, E.J. (Cornell Univ., Ithaca, NY). *Phys. Lett., A;* **53A**: No. 5, 410-412(14 Jul 1975).

The abrupt change in voltage-current characteristic of a Nb—10 at. percent Mo alloy observed as H is increased past a peak in the critical current implies a change in the mechanism of flux line lattice motion at the peak. (auth)

6950 **Tilted-field radio-frequency size effect in tungsten.** Baer, D.R. (Cornell Univ., Ithaca, NY). *Phys. Rev., B;* **12**: No. 8, 3046-3053(15 Oct 1975).

The radio-frequency size effect (RFSE) was studied in tungsten plates in a magnetic field inclined at an angle to the sample surface using a transmission method. A parametrized model of the tungsten Fermi surface and the geometric model of the RFSE was combined to allow calculation of expected signal positions. Most of the well-defined experimental signals are identifiable using the model and there is general agreement between the experimental data and the calculated signal locations. The relation of the tilted-field RFSE signals to Gantmakher—Kaner oscillations is also discussed. (auth)

6951 **Magnetic properties of the ThCo/sub 5-x/Ni/sub x/ system.** Narasimhan, K.S.V.L.; Do-Dinh, C.; Wallace, W.E.; Hutchens, R.D. (Department of Chemistry, University of Pittsburgh, Pittsburgh, Pennsylvania, 15260). *J. Appl. Phys.;* **46**: No. 11, 4961-4964(Nov 1975).

Magnetic moments, Curie temperatures, and anisotropy fields are presented for ThCo/sub 5-x/Ni/subx/ ternaries for temperatures ranging from 4.2 to 300 K. $ThNi_5$ is a Pauli paramagnet. The Co moment in $ThCo_5$ is 1.16 μ/subB/ per atom. The reduction below 1.7 μ/subB/ for elemental cobalt is ascribed to electron transfer from Th to Co together with shifts in the relative positions of the cobalt 3d subbands. The variation of anisotropy field with composition supports the notion that the magnetic anisotropy of $ThCo_5$ originates largely with Co in the 2(c) sites. The coercive force, measured at 4.2 K, increases with nickel content attaining a value of 20 kOe for $ThCo_{3.5}Ni_{1.5}$. This alloy has at 4.2 K an energy product of 2.6 MG Oe. (AIP)

6952 **Effect of excess Au on antiphase domain growth in Cu_3Au.** Rase, C.L.; Mikkola, D.E. (General Motors Corp., Saginaw, MI). *Metall. Trans., A;* **6A**: No. 12, 2267-2271(Dec 1975).

The kinetics of antiphase domain growth have been studied in three nonstoichiometric Cu_3Au alloys containing nominally 26, 28, and 31.5 at. percent Au. During isothermal annealing of disordered samples below the critical temperatures, the domain growth in all of the alloys initially followed the same t/sup 1/2/ dependence found previously for stoichiometric Cu_3Au. At long times, the two alloys furthest off stoichiometry reached limiting domain sizes which decreased with increasing Au content. Although the role of the excess Au in determining these limiting sizes is not clear, it is evident that most of the excess Au is accommodated within the domains. The antiphase domain size distributions in the alloys agree with those found for the stoichiometric alloy. (auth)

CORROSION AND EROSION

6953 (CONF-751101—39) **Self-welding evaluation of reactor materials in flowing sodium.** Chang, J.Y.; Flagella, P.N.; Schrock, S.L. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). 1975. 3p. Dep. NTIS $4.50.

From Joint meeting of the American Nuclear Society and the Atomic Industrial Forum; San Francisco, California, USA (16 Nov 1975).

An experimental study was made of the self-welding of various combinations of FBR materials (304 ss, Inconel 718, A286, Stellite 156, and Stellite 6) in sodium at 800 to 1100°F for time periods up to 6 months and contact stresses of 2 to 148 ksi. Stresses required to separate the surfaces were determined. Self-welding was observed only at temperatures of 1050°F and above, with the breakaway force being less than 5 ksi. (DLC)

6954 (ICP—1071) **Corrosion monitoring of storage bins for radioactive calcines.** Hoffman, T.L. (Allied Chemical Corp., Idaho Falls, Idaho (USA). Idaho Chemical Programs - Operations Office). Oct 1975. Contract E(10-1)-1375. 18p. Dep. NTIS $4.00.

Highly radioactive liquid waste produced at the Idaho Chemical Processing Plant is calcined to a granular solid for long-term storage in stainless steel bins. Corrosion evaluation of coupons withdrawn from these bins indicates excellent performance for the materials of construction of the bins. At exposure periods of up to six years the average penetration rates are 0.01 and 0.05 mils per year for Types 304 and 405 stainless steels, respectively. (auth)

6955 (IFTJ—70/PS) **Crystallographic structure and magnetic properties of the $(FeCr)_3Al$ phase in $Fe_{0.67}Cr_{0.08}Al_{0.25}$ alloy.** Litynska, L.; Niziol, S. (Institute of Physics and Nuclear Techniques, Krakow (Poland)). 1975. 15p. (In Russian). Dep. NTIS (US Sales Only) $3.50.

The degree of atomic order and magnetic properties of $Fe_{0.67}Cr_{0.08}Al_{0.25}$ alloy were investigated. X-ray and neutron diffraction methods reveal the existence of crystallographic structure of the type $(FeCr)_3Al$ in this alloy. In the ordered state of the sublattices Fe(I), Fe(II), a significant decrease of the value of the magnetic moment was observed, as compared with the case of alloy. (auth)

6956 (RFP—2351) **Corrosion-induced acoustic emissions from uranium 4.5—weight percent niobium binary alloy.** Mah, R.; Kochen, R.L.; Macki, J.M. (Atomics International Div., Golden, Colo. (USA)). 15 Dec 1975. Contract E(29-2)-3533. 10p. Dep. NTIS $4.00.

The ability to monitor corrosion and stress-corrosion cracking of uranium 4.5-weight percent niobium was investigated. The acoustic emissions from stress-corrosion cracking were monitored using smooth four-point bend specimens, which were immersed in oxygen-saturated water containing chloride ions. The acoustic emissions from corrosion were monitored from rectangular corrosion coupons. These latter specimens were exposed to nitrogen-saturated and oxygen-saturated solutions of distilled water and distilled water with chloride ions. Dilute solutions of hydrochloric acid were also used. Findings show that stress-corrosion crack monitoring of the alloy was successful. Corrosion monitoring of the alloy showed a direct correlation between corrosion rate (based on weight loss) and total acoustic emissions. For a specific range, one can calculate the corrosion rate of uranium alloys in a corrosive solution from the total acoustic emissions generated. Studies to determine the source of corrosion-induced acoustic emissions were inconclusive.

6957 (Y—1999) **Effect of aging on the general corrosion and stress corrosion cracking of uranium—6 wt % niobium alloy.** Koger, J.W.; Ammons, A.M.; Ferguson, J.E. (Oak Ridge Y-12 Plant, Tenn. (USA)). Nov 1975. Contract W-7405-eng-26. 26p. Dep. NTIS $4.00.

Mechanical properties of the uranium-6 wt percent niobium alloy change with aging time and temperature. In general, the ultimate tensile strength and hardness reach a peak, while elongation becomes a minimum at aging temperatures between 400 and 500°C. The first optical evidence of a second phase was in the 400°C-aged alloy, while complete transformation to a two-phase structure was seen in the 600°C-aged alloy. The maximum-strength conditions correlate with the minimum stress corrosion cracking (SCC) resistance. The maximum SCC resistance is found in the as-quenched and 150, 200, and 600°C-aged specimens. The as-quenched and 300°C-aged specimens had the greatest resistance to general corrosion in aqueous chloride solutions; the 600°C-aged specimen had the least resistance. (auth)

6958 (UCRL-Trans—10961) **Selection of steel for pipes designed for equipping the Orenburg field.** Zakharov, Yu.V.; Afanasev, V.P.; Legezin, N.E. Translated from *Korroz. Zashch. Neftegazov. Prom-sti.*; No. 3, 20-23(1972). 8p. Dep. NTIS $4.50.

The corrosion resistance of industrial steels to natural gas from wells in the Orenburg field was studied. It was found that there was no difference in corrosion rate depending on the chemical composition of the steels being studied and their thermal processing. The average rate of corrosion for 10 days, calculated according to the results of testing more than 60 samples, was 0.2 mm/year. (JRD)

6959 **CORROSION PROBLEMS IN ENERGY CONVERSION AND GENERATION. SYMPOSIUM HELD IN NEW YORK CITY, OCTOBER 15—17, 1974.** Tedman, C.S. Jr. (ed.). Princeton, NJ; United States of America (USA); Electrochemical Society, Inc. (1974). 479p. (CONF-7410138—).

From Proceedings of the symposium on corrosion problems in energy conversion and generation; New York, New York, USA (15 Oct 1974).

This book, containing 28 papers, is divided into four parts dealing with corrosion problems in electrochemical energy conversion, gas turbine technology, advanced energy generation and conversion systems (such as HTGR, MHD, FBR), and modern nuclear technology. Separate abstracts were prepared for nine in NSA scope and for three in ERA scope; five others were indexed for EDB. (DLC)

6960 (UCRL-Trans—10960) **Corrosion testing of metals under stress using gas industry conditions.** Myasnikov, Yu.F.; Asviyan, M.B.; Sakharov, Yu.V.; Vasilev, P.E.; Legezin, N.E. Translated from *Korroz. Zashch. Neftegazov. Prom-sti.*; No. 4, 9-11(1974). 9p. Dep. NTIS $4.50.

Methods of corrosion testing of metals under stress are described and evaluated. Several construction steels were studied to determine their sulfide cracking resistance. Results indicate that the time before fracture decreases with an increase in the maximal strength and solidity of the steels. Less hard steels after corresponding thermal processing do not have a tendency toward sulfide cracking. These two conclusions do not contradict the generally accepted concept of the principles of sulfide cracking, which allows the use of proposed methods of creating a stressed condition in the metals for a comparative evaluation of the resistance of the steel to sulfide cracking both in the laboratory and under industrial conditions. With this, it is possible to obtain information about changes in the mechanical properties of the metals in the process of corrosion testing. (auth)

6961 **Hydrogen transport in austenitic stainless steel.** Louthan, M.R. Jr.; Derrick, R.G. (Savannah River Lab., Aiken, SC). *Corros. Sci.*; **15**: No. 9, 565-577(Oct 1975).

The permeability, diffusivity, and solubility of hydrogen in austenitic stainless steels were determined by analyzing the time-temperature dependence of deuterium flux through foil specimens. For a variety of such steels, the temperature dependence of these transport properties is given by: phi = 6 x 10^{-3} exp (-14,300/RT)cc(NTP)/(cm-atm/sup $^1/_2$/-s), D = 4.7 x 10^{-3} exp (-12,900/RT)cm^2/s, C = 1.28 exp (-1,400/RT)cc(NTP)/(cm^3-atm/sup $^1/_2$/). These equations lie within the range of reported values. Much of the scatter between the results of previous investigators probably resulted from surface control of permeation. Surface effects were minimized in the current study; therefore, the above equations should approximate diffusion-controlled hydrogen transport. (auth)

6962 **Diffusional effects in simulated localized corrosion.** Tester, J.W.; Isaacs, H.S. (Oak Ridge National Lab., TN). *J. Electrochem. Soc.*; **122**: No. 11, 1438-1445(Nov 1975).

The importance of diffusion was investigated under potentiostatic dissolution conditions with wire electrodes contained in inert supports. The artificial cavities created simulated localized corrosion conditions. Current-time behavior at voltages in excess of the critical pitting potential [>0.5V (SCE)] was examined for nickel and stainless steel specimens in concentrated chloride solutions. The effect of changing the concentration or activity gradient of the dissolving metal cations within the artificial cavity was studied by alternating the composition of the bulk solution. Solutions of $FeCl_2$, $NiCl_2$, $CrCl_3$, LiCl, NaCl, $MgCl_2$, and $CeCl_3$ ranging from 0.5 to 10M were used. Mass transfer models were developed for the observed transient and quasi steady-state periods of dissolution. (auth)

RADIATION EFFECTS

6963 (BMI—1938) **Progress on evaluating strength and ductility of irradiated Zircaloy during July through September 1975. Quarterly progress report on Task Agreement No. 61.** Bauer, A.A.; Lowry, L.M.; Perrin, J.S. (Battelle Columbus Labs., Ohio (USA)). Sep 1975. Contract W-7405-eng-92. 34p. Dep. NTIS $4.00.

The characterization of fuel rods from the H. B. Robinson Power Plant was continued with the evaluation of gamma-scan, profilometry, plenum-gas, and burnup data. The rods exhibit varying degrees of ovality but no other clear evidence of cladding deformation. A good correlation exists between burnup and intensity of gross gamma activity. Isothermal and transient annealing studies have been completed on the cladding of Point Beach fuel rods. Hardness tests of isothermally annealed specimens are distinguished by the lack of time dependence evidenced in the hardness changes recorded. A pronounced dependence of hardness on heating rate and maximum temperature is observed for transient annealed specimens. Tensile test results indicate that recovery of strength properties precedes recovery of ductility both during low-temperature isothermal and during transient annealing treatments. Metallographic evidence shows that recrystallization of the cold-worked and irradiated Zircaloy cladding begins at some temperature between 1000 and 1150°F. (auth)

6964 (CONF-751006—21) **X-ray studies of irradiation induced dislocation loops in metals.** Larson, B.C. (Oak Ridge National Lab., Tenn. (USA)). 1975. 10p. Dep. NTIS $4.50.

From International conference on radiation damage in metals; Gatlinburg, Tennessee, USA (5 Oct 1975).

Theoretical and experimental progress has resulted in the increased use of x-rays for the study of defects and defect clusters in crystals. An outline of the theoretical framework associated with Huang, Stokes-Wilson and integral diffuse scattering from dislocation loops is presented, and an account of recent experiments on radiation induced loops is given. These studies include low temperature, ambient temperature, and elevated temperature irradiations of metals with electrons, neutrons, and accelerated ions, and pertain to the study of the thermal annealing characteristics as well as the as-produced damage structure. The information obtained by x-rays as to the type, size and concentrations of dislocation loops is contrasted with existing electron microscopy, electrical resistivity, and lattice parameter data in order to establish correlations and identify areas of disagreement. (auth)

6965 (CONF-751006—22) **Nature of defect clusters in electron-irradiated copper.** Ohr, S.M. (Oak Ridge National Lab., Tenn. (USA)). 1975. 7p. Dep. NTIS $4.50.

From International conference on radiation damage in metals; Gatlinburg, Tennessee, USA (5 Oct 1975).

An electron microscope study has been made of the clustering of point defects in electron-irradiated copper in the range of temperatures between Stage III and Stage V. The samples used were single crystals of copper irradiated at 4°K with 3 MeV electrons to a dose of 1.4 x 10^{19} electrons/cm^2. In all of the samples examined the defect clusters were in the form of dislocation loops,

mostly less than 100 A in diameter. In samples warmed to room temperature, i.e. slightly above Stage III, the analysis of black-white contrast showed that the loops present were entirely of the interstitial type. In samples annealed at 90 and 150°C, the defects were predominantly loops of interstitial type, but approximately 10 percent of the loops were of vacancy type. At 250°C, the fraction of the loops of vacancy type increased to about 40 percent but the total loop density decreased markedly. The evidence seems to indicate that in Stage III vacancies do not cluster into sizes large enough to be visible in the electron microscope. (auth)

6966 (GEAP—14062) **Swelling of types-304 and -316 stainless steel irradiated to $8x10^{22}$ n/cm².** Busboom, H.J.; McClellan, G.C.; Bell, W.L.; Appleby, W.K. (General Electric Co., Sunnyvale, Calif. (USA). Breeder Reactor Dept.). Jul 1975. Contract AT(04-3)-893. vp. AT.

Samples of Types-304 and -316 stainless steels covering a range of prior heat treatments and extent of cold working were irradiated in EBR-II to fluences of approximately 8×10^{22} n/cm² at temperatures from 450 to 675°C. The results define the temperature dependence of swelling for these materials and show a temperature of irradiation for which swelling is a maximum. Cold working was found to be more effective in reducing swelling in Type-316 than in Type-304 stainless steel. The lowest maximum swelling was 0.5 percent ΔV/V in 30 percent cold worked Type-316, compared to 2 percent ΔV/V in the 20 percent cold worked condition and 4 percent ΔV/V in the annealed material. Irradiation of prime specimens is being continued toward a fluence of 1.5×10^{23} n/cm². Swelling of sodium-exposed materials on irradiation is also being studied. (auth)

6967 **A proposed method of calculating displacement dose rates.** Norgett, M.J. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment); Robinson, M.T. (Oak Ridge National Lab., Tenn. (USA)); Torrens, I.M. (CEA Centre d'Études Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Section de Recherches de Metallurgie Physique). *Nucl. Eng. Des.*; **33**: No. 1, 50-54(Aug 1975).

A simple procedure is proposed for calculating the number of atomic displacements produced in a damage cascade by a primary knock-on atom of known energy. The formulae have been chosen to give results in close accord with recent computer simulations of radiation damage phenomena. The proposed new standard is compared with other empirical formulae for estimating the number of atomic displacements in a cascade. (NL)

6968 (IS-M—49) **Influence of oxygen impurity atoms on defect clusters and radiation hardening in neutron-irradiated vanadium.** Bajaj, R.; Wechsler, M.S. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.; Ames Lab., Iowa (USA); Iowa State Univ. of Science and Technology, Ames (USA)). 1975. 8p. (CONF-751006—19). Dep. NTIS $4.50.

From International conference on radiation damage in metals; Gatlinburg, Tennessee, USA (5 Oct 1975).

Single crystal TEM samples and polycrystalline tensile samples of vanadium containing 60-640 wt ppM oxygen were irradiated at about 100°C to about 1.3×10^{19} neutrons/cm² (E greater than 1 MeV) and post-irradiation annealed up to 800°C. The defect cluster density increased and the average size decreased with increasing oxygen concentration. Higher oxygen concentrations caused the radiation hardening and radiation-anneal hardening to increase. The observations are consistent with the nucleation of defect clusters by small oxygen or oxygen-point defect complexes and the trapping of oxygen at defect clusters upon post-irradiation annealing. (auth)

6969 (IS-M—50) **Radiation embrittlement of metals and alloys.** Wechsler, M.S. (Ames Lab., Iowa (USA); Iowa State Univ. of Science and Technology, Ames (USA)). 1975. 19p. (CONF-751006—20). Dep. NTIS $4.50.

From International conference on radiation damage in metals; Gatlinburg, Tennessee, USA (5 Oct 1975).

Three types of radiation embrittlement are identified: (1) radiation embrittlement in nominally ductile metals, (2) radiation embrittlement in metals that undergo a ductile-brittle transition, and (3) high-temperature grain boundary embrittlement. This paper deals with type (1) and, more briefly, type (2) radiation embrittlement. Radiation embrittlement in nominally ductile metals is characterized by the premature onset of plastic instability, which causes a sharp decrease in the macroscopic plastic strain that the material can sustain before necking (uniform strain) and breaking (fracture strain). Dislocation channeling seems to be largely responsible and experimental results are reviewed. The origin of dislocation channeling is discussed. Irradiated metals that exhibit a ductile-brittle transition show an increase in the transition temperature but the nature of the transition (shear to cleavage fracture) does not appear to be greatly altered. A key factor is the temperature dependence of yielding and how it is affected upon irradiation. Impurities exert an influence on the stability of radiation-produced defect clusters and thus can alter the amount of radiation embrittlement experienced upon irradiation at somewhat elevated temperatures. In general, radiation embrittlement appears to stem mostly from changes in plastic properties (particularly in the trend toward more dynamic and inhomogeneous plastic deformation) rather than from changes in the inherent fracture process. 63 references, 10 figures. (auth)

6970 (SAND—75-5519) **Physical state of implanted W in copper.** Borders, J.A.; Cullis, A.G.; Poate, J.M. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1975. 14p. (CONF-750926—3). Dep. NTIS $4.00.

From International conference on applications of ion beams to materials; Warwick, UK (9 Sep 1975).

6971 **The conversion of displacement production to defect production in stainless steel through computer experiments.** Doran, D.G. (Hanford Engineering Development Lab., Richland, Wash. (USA)). *Nucl. Eng. Des.*; **33**: No. 1, 55-62(Aug 1975).

There is a growing need to correlate radiation effects data obtained with neutron and charged particles. The exposure unit, displacements per atom, is generally inadequate for this purpose. A description is given of a computer experiment methodology that permits estimation of the numbers and types of residual defects produced by various irradiation environments. Application is made to neutron spectra characteristics of two fast reactors. (NL)

6972 **The calculation of displacement rates in stainless steel under neutron and electron irradiations.** Doran, D.G. (Hanford Engineering Development Lab., Richland, Wash. (USA)). *Nucl. Eng. Des.*; **33**: No. 1, 63-77(Aug 1975).

49 refs.

The calculation of displacement rates in neutron and electron irradiations is reviewed. Comparisons are made of neutron displacement cross sections calculated using several secondary displacement models. Included are comparisons of some spectrum-averaged cross sections for EBR-II and FFTF spectra. The status of electron displacement cross sections is reviewed. An exercise is performed to deduce neutron and electron cross sections consistent with an assumed direction dependent damage energy threshold. It is suggested that neutron-electron damage correlations should be based on free defect cross sections rather than displacement cross sections. (NL)

6973 **Enhanced diffusion of Zn in Al under high-flux heavy-ion irradiation.** Myers, S.M.; Picraux, S.T. (Sandia Laboratories, Albuquerque, New Mexico 87115). *J. Appl. Phys.*; **46**: No. 11, 4774-4776(Nov 1975).

Zinc diffusion in Al has been enhanced by factors ~ 10^2-10^6 under 80-keV Ne and 160-keV Ar irradiation at damage rates approximately <1 dpa/sec (dpa=displacements per atom). The Ne bombardment was varied in flux in the range $(1.4—70) \times 10^{13}$ atoms/cm² sec, and in temperature in the range 50—130°C. The enhanced diffusion coefficient is linear in Ne flux and nearly independent of temperature, both consistent with annihilation of mobile defects at fixed sites. Analysis indicates that the average diffusion distance to annihilation for mobile defects is ~ 1000 A, and that one mobile defect is created for ~ 10^3 atomic displacements. (AIP)

6974 **Critical current changes in Nb_3Sn irradiated with fast neutrons at 6 K.** Brown, B.S.; Blewitt, T.H.; Wozniak, D.G.; Suenaga, M. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439). *J. Appl. Phys.*; **46**: No. 12, 5163-5168(Dec 1975).

Multifilament copper-clad wires of Nb_3Sn have been irradiated at 6 K to a dose of 1.8×10^{18} n/cm² (E>0.1 MeV). The critical current (J/sub c/) was measured as a function of dose and applied magnetic field to 33 kOe. After 1.2×10^{18} n/cm², an increase of 33% in J/sub c/ occurred at 33 kOe from an initial value of 1.5×10^6 A/cm² at 4.5 K. The increase was smaller at lower applied fields, and J/sub c/ actually decreased for H<8 kOe. For all fields, the increase in J/sub c/ eventually saturated and then decreased as the dose increased, with the saturation dose increasing with increasing applied field. The critical temperature (T/sub c/) changed by <1 K at the highest dose. Approximately 25% of the change in J/sub c/ recovered after a 295 K anneal. The J/sub c/ changes are explained as an increase in flux pinning from radiation-induced defect cascades that leads to an increase in J/sub c/ greater than the decrease in J/sub c/ which results from a decrease in T/sub c/ of 1 K and from the increase in H/sub c_2 produced by the increase in normal resistivity. A model is proposed that allows the prediction of the dose dependence of various terms in the pinning-force density and explains the field and dose dependence of the J/sub c/ changes. Measurements of the superconduct-

ing—to—normal-state thermal transition indicate that the decrease in thermal conductivity of the Cu cladding is important when considering the degradation of the thermal transition current that occurs at high doses. (AIP)

CERAMICS, CERMETS, AND REFRACTORIES

PREPARATION AND FABRICATION

6975 (RFP-Trans—171) **Study of glasses with reduced alkali content. Glass formation and certain properties of glasses of the system SiO_2—Al_2O_3—MgO—Na_2O—NaCl.** Ermolenko, N.N.; Shamkalovich, V.I.; Skripko, G.G. Translated from *Steklo, Sitally Silik. Mater.*; No. 1, 47-52(1970). 6p. Dep. NTIS $4.50.

Properties of glasses as affected by composition were studied. Observations of glass clarity, crystallization mechanisms, softening points, production and handling properties, thermal expansion, and alkali resistance are presented. Development of an optimum glass composition is reported. (JRD)

STRUCTURE AND PHASE STUDIES

6976 (UCRL-Trans—10951) **Crystal structure of BeB_2.** Mattes, R.; Tebbe, K.F.; Neidhard, H.; Rethfeld, H. Translated from *Z. Anorg. Allg. Chem.*; **413**: No. 1, 1-9(1975). 15p. Dep. NTIS $4.50.

The crystal structure of the boride $Al_{0.06}BeB_{2.05}$ was determined by three-dimensional x-ray analysis. The unit cell dimensions are: a = 9.800(1) A, c = 9.532(1) A; I = 26.6; space group: P6/mmm; density 2.43 g/cm^{-3}. The complex structure contains B_{12} icosahedra and other polyhedral units occupied by boron and beryllium atoms. The linkage between the polyhedra is related to the linkage of B_{12} icosahedra in β-rhombohedral boron. The aluminium atoms occupy interstitial sites. (auth)

6977 **Chemistry of vaporization of refractory materials.** Gilles, P.W. (Univ. of Kansas, Lawrence). *J. Am. Ceram. Soc.*; **58**: No. 7-8, 279-284(1975).

A discussion is given of the principles of physical chemistry important in vaporization studies, notably the concepts of equilibrium, phase behavior, thermodynamics, solid solution, and kinetics. The important factors influencing equilibrium vaporization phenomena are discussed and illustrated. A proper course of a vaporization study consisting of 9 stages is proposed. The important experimental techniques of Knudsen effusion, Langmuir vaporization and mass spectrometry are discussed. The principles, the factors, the course of a study and the experimental techniques and procedures are illustrated by recent work on the Ti–O system. (auth)

6978 **Moessbauer effect study of ^{57}Fe in transition metal monoborides.** DeYoung, D.B.; Barnes, R.G. (Ames Lab., IA). *J. Chem. Phys.*; **62**: No. 5, 1726-1738(1 Mar 1975).

The phase characteristics and nuclear hyperfine properties of 45 transition metal monoborides M/sub 1 - x/ Fe/sub x/B were studied by Moessbauer effect spectroscopy of ^{57}Fe. Transmission measurements with powders were completed in the temperature range 4.2 to 1000°K; additional scattering and 18 kOe applied field data were collected at 300°K. Measured ^{57}Fe nuclear hyperfine parameters are discussed in terms of atomic bonding, charge transfer, and spontaneous magnetism in the borides. Within the context of the rigid band model, the isomer shift data for all boride phases indicate an electron transfer from boron to the metal 3d band. Similarly, the effective magnetic hyperfine field in ferromagnetic monoborides is proportional to the magnetization and also reveals a possible charge transfer from boron to metal. Quadrupole coupling constant results show a strong ionic contribution to the electric field gradient at the ^{57}Fe site in the monoborides. Measurements on FeB confirm the existence of two distinct structural modifications possessing different magnetic hyperfine fields but the same Curie temperatures. The defect (α) phase of FeB appears to be stabilized by the addition of manganese. (auth)

6979 **Atom vacancies and their effects on the properties of NbN containing carbon, oxygen, or boron. I. Phase boundary, thermodynamics, and lattice parameter.** Storms, E.K. (Los Alamos Scientific Lab., NM). *High Temp. Sci.*; **7**: No. 2, 103-121(Jun 1975).

The NbC-NbN and NbN-NbO systems were studied by density and lattice parameter measurements to determine the concentration of atom vacancies in the metal and nonmetal sublattices of the cubic (Bl) structure as a function of pressure, temperature, and composition. Equations are given which define the thermodynamic behavior. Metal vacancies which occur near the nitrogen rich end of the NbN-NbC system and throughout the NbN-NbO system have a marked effect on the lattice parameter. The behavior of the lattice parameter can be explained if the niobium atoms increase in size in proportion to the number of electrons transferred from the nonmetal sublattice. The phase boundary of the cubic phase at 1643°K and 1.0 is $Nb_{0.99}N_{0.92}$. Dissolved oxygen and to a less extent carbon cause the atom ratio at this boundary to increase. Equations are given which allow the boundary to be calculated at other temperatures and pressures. 13 figures. (auth)

6980 **Surface and interface electronic structure of GaAs and other III-V compounds.** Spicer, W.E.; Gregory, P.E. (Stanford Univ., CA). *CRC Crit. Rev. Solid State Sci.*; **5**: No. 2, 231-242(Sep 1975).

A model of the surface states of the (110) GaAs crystal face is presented. Data and information are included on the electronic structure of the intrinsic (110) GaAs surface, generalization of the model to other crystal faces, and interface states. (JRD)

6981 **Morphology relations during bulk-transport sintering.** German, R.M.; Munir, Z.A. (Sandia Labs., Livermore, CA). *Metall. Trans., A*; **6A**: No. 12, 2229-2234(Dec 1975).

Based on a minimum neck surface area, geometric relationships describing the morphology of sintering spheres have been mathematically established. Calculations resulting from this model give the relative shrinkage and surface area reduction as functions of both neck size and particle coordination. The specific surface area is shown to decrease monotonically with neck growth and to be a sensitive ve measure of sintering progression. An empirical relationship between neck size, coordination, and surface area is derived. Previously published shrinkage results are found to be in good agreement with those predicted by the proposed model. Prediction of the kinetics of surface area reduction and assessment of the relative contribution of surface and bulk-transport processes are now possible through the relationships generated from this model. (auth)

PHYSICAL PROPERTIES

6982 (COO—3151-60) **Polarizability of the low frequency excitations in disordered solids.** Stephens, R.B. (Cornell Univ., Ithaca, N.Y. (USA). Lab. of Atomic and Solid State Physics). Oct 1975. Contract AT(11-1)-3151. 24p. Dep. NTIS $4.50.

An attempt to find manifestations of an electric dipole moment associated with the low-temperature thermal properties of glasses has enabled the setting of very low limits for GeO_2 and PMMA, 0.06 and 0.16 Debye respectively. Measurements of the temperature dependence of the dielectric constant and the electric field dependence of the thermal conductivity of SiO_2 in conjunction with dielectric measurements by Schickfus et al. has pinned down some of the features of a tunneling systems model. The potentials must be nearly symmetric (Δ_0>> Δ/sub A/) and the distribution of these states, n(Δ)/sub tun/, must be considerably more uniform than one would calculate from measurements of the specific heat of SiO_2, n(Δ)/sub C/sub p/. (auth)

6983 **Examination of the total pressure over hypostoichiometric uranium dioxide.** Winslow, G.H. (Argonne National Lab., IL). *High Temp. Sci.*; **7**: No. 2, 81-102(Jun 1975).

The standard free energy of formation of stoichiometric UO_2 is reevaluated. An altered valent cation model, descriptive of the oxygen potential throughout the hypostoichiometric domain of urania, is integrated analytically so that activities of (U) and of (UO_2) and the free energies of formation of [UO/sub 2-x/] can be evaluated. By including separately determined values for the vapor pressure of uranium and the free energy of formation of (UO_3) and by imposing the independence of composition of ΔG^0/sub integral/(UO) as a condition, the latter and $p^0(UO_2)$ are determined from observations of the total pressure of uranium bearing species. This resolution of the total pressure of uranium-bearing species plus the starting equations for the oxygen potential enable determination of the congruently vaporizing compositions, which are found to be much nearer stoichiometry than are experimental results. By including separately determined mass spectrometric observations of (I^+T) at the lower phase boundary, evaluations are made of the instrument sensitivities for the various species in the gas phase. While the model well describes the observations of oxygen potential, it leads to obviously erroneous contributions to the enthalpy of stoichiometric uranium dioxide. 11 figures, 60 references. (auth)

6984 **Acoustic modes of the phonon dispersion relation of NbD/sub x/ alloys.** Rowe, J.M. (National Bureau of Standards, Washington, DC); Vagelatos, N.; Rush, J.J.; Flotow, H.E. *Phys. Rev., B*; **12**: No. 8, 2959-2964(15 Oct 1975).

The acoustic modes of the phonon dispersion relation in Nb, $NbD_{0.15}$, and $NbD_{0.45}$ were measured at 473°K for phonons

with wave vectors along the [100], [110], and [111] axes by coherent neutron scattering. The observed neutron groups for both alloys were well defined, with little or no apparent broadening. Results are compared to similar data for Nb—Mo alloys and with previous lattice-dynamics results for $PdD_{0.63}$. This comparison shows that despite differences in detail, the general features of the dispersion relations of NbD/sub x/ and Nb—Mo are similar after allowing for the differences in lattice parameters for the two alloys. The measured dispersion curves and derived phonon frequency distributions for the Nb—D alloys are quite different from the analogous results for $PdD_{0.63}$ in that the average acoustic phonon frequencies increase with increasing deuterium concentration and lattice parameter. (auth)

COMPOSITE MATERIALS

STRUCTURE AND PHASE STUDIES

6985 **Coarsening of eutectic fiber composites during cooling from the eutectic temperature.** Garmong, G. (Rockwell International Science Center, Thousand Oaks, CA); Courtney, T.H. *Metall. Trans., A;* **6A**: No. 10, 1945-1948(Oct 1975).

Coarsening and microstructural changes, which occur on cooling from the eutectic temperature, were experimentally studied in Al–Al_3Ni eutectic fiber composites solidified at rates of 0.8, 5.0 and 32.5 cm per h. At the two higher growth rates, changes in fiber density on the order of 10 percent were observed between the solid-liquid interface and positions 2.0 cm from the interface. At the low growth rate the surface roughness of the as-grown fiber was noticeably decreased during cooling from the eutectic temperature. Theoretical expressions relating the change in average fiber radius or fiber density as a function of position were developed in terms of the solidification conditions, growth rate and temperature gradient, as well as the usual kinetic and thermodynamic factors influencing coarsening. The model was combined with independently obtained isothermal coarsening data to compare the experimentally observed extent of coarsening with that predicted. The predictions of the model agreed qualitatively with the data on the effect of growth rate on coarsening, but the absolute extent of coarsening was greater than that predicted from the isothermal studies. (auth)

MECHANICAL PROPERTIES

6986 **Reinforcement of epoxy resins with potassium titanate whiskers.** Mallick, P.K.; Broutman, L.J. (Illinois Inst. of Tech., Chicago). *Polym. Eng. Sci.;* **14**: No. 9, 656-659(Sep 1974).

Fybex is a newly available potassium titanate whisker. Its usefulness as a reinforcement for a thermosetting epoxy resin is examined. The effect of surface treatment on the mechanical properties of the composite system is also considered. (auth)

6987 (UCRL-Trans—10929) **Interim report for the German Research Agency (Bonn, Bad Godesberg) on the projects: AH 12/6: study of the crack resistance of fiber-reinforced plastics; and AH 12/10: use of new nondestructive tests for early detection of damage in composite materials subjected to alternating loads. Period covered: 1 May 1973—30 April 1974.** Schwalbe, H.J. (Battelle-Institut e.V., Frankfurt am Main (F.R. Germany)). Sep 1975. Translated from a German report. 46p. Dep. NTIS $5.00.

Four types of failure in GFK and KFK laminates were investigated. Those are distinguished by macroscopic course of rupture, stress-strain behavior, and associated micro-rupture processes. Unstable crack growth, as is known for homogeneous isotropic materials, is observed with the investigated laminates only in the case of damage type 4 (crack front and notch in the laminate plane). In this case, it also seems to be possible to determine a K/sub IC/ value. Specimens with other notch orientations are characterized by stable crack growth. In these cases, the energy which must be supplied to bring about complete failure after initial fiber rupture seems to be a measure of the "crack resistance" of the composite. GFK specimens of different laminate structure show the same rupture behavior under cyclic loading (pulsating compression loading in the three-point bend test) as they do in the static test. The cumulative total of sound emission pulses shows a constant value at ultimate failure. For the same loaded cross section, this value is independent of the loading rate, upper/lower load, number of cycles, and position of the notch relative to fiber direction when the notch is perpendicular to the layers of the laminate. As far as can be ascertained from the present results, this value, although not a material constant, is a criterion by which danger to the specimens can be evaluated. For composite materials, sound emission analysis has proved to be a test method which provides early indication of any material change. It is capable of distinguishing between fiber rupture and rupture between fibers, (damage such as resin crack formation, debonding and delamination). (auth)

POLYMERS AND PLASTICS

MECHANICAL PROPERTIES

6988 **Adhesive properties of urethane resin.** DeLollis, N.J. (Sandia Labs., Albuquerque, NM). *SAMPE Q.;* **6**: No. 4, 8-10(Jul 1975).

The adhesive and bulk properties of a polyol cured methylene diphenyl diisocyanate (MDI) urethane resin being evaluated as a replacement for a MOCA cured urethane resin system are described. To verify that the adhesive aging studies do describe interfacial rather than bulk phenomena, shear moduli of the bulk resin system were studied with and without aging. The adhesive strength properties were evaluated at room temperature with and without aging at 74°C and at constant high humidity with thermal cycling. In addition, the durability of the bond is evaluated with and without the addition of an epoxy terminated silane primer. (auth)

OTHER MATERIALS

STRUCTURE AND PHASE STUDIES

6989 (LA-tr—75-45) **Equation of state of molecular phase hydrogen in the solid and liquid states at high pressure.** Grigoriev, F.V.; Kormer, S.B.; Mikhailova, O.L.; Tolochko, A.P.; Urlin, V.D. Translated by A.D. Cernicek from *Zh. Eksp. Teor. Fiz.;* **69**: 743-749(1975). 11p. Dep. NTIS $3.50.

Parameters of the equations of state of molecular hydrogen in the solid and liquid states are found. The calculated isotherms, shock adiabats, fusion curves, and isentropy curves are in good agreement with the experimental data. A new result for isentropic compression at rho = 0.67 g/cm³ and P approximately 1 Mbar is obtained for the molecular phase of hydrogen. 4 figures, 3 tables (auth)

PROPERTIES

6990 (ITP—75-25R) **Application of the collective variable method to the investigation of the electrolyte film.** Yukhnovskii, I.R.; Kurylyak, I.I. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1975. 33p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The electrolyte film limited by different medium is considered. The Hamiltonian of the system is constructed. The explicit expressions for the S-particle distribution function are obtained. The one-particle distribution function in the zero approximation for the continuum model is computed. The ion density distribution curves inside the film limited by different medium are built. The cluster expansions for the S-particle distribution function are obtained up to the cluster integrals with two field vertices. (auth)

6991 (MLM—2192) **Conductive polystyrene bead foam material.** McGraw, H.R.; Hood, W.L. (Mound Lab., Miamisburg, Ohio (USA)). 30 Dec 1975. Contract E-33-1-GEN-53. 17p. Dep. NTIS $4.00.

Polystyrene bead foam has excellent qualities for use in packaging. However, its very high electrical resistance permits the buildup of electrostatic charges which may be a problem for some items, such as explosive devices. A paint was found that adheres well to polystyrene bead foam and affords an electrically conductive surface that readily discharges any electrostatic charges imposed on it. The alternate method for making the polystyrene bead foam conductive by adding the conductive material prior to forming the foam was tried with beads coated with carbon. The resulting foamed specimens had suitable electrical conductivities but were unsatisfactory because of their low structural strengths. (auth)

6992 (SAND—75-8740) **Theory of diffusion and trapping of hydrogen and helium in metals, a review.** Wilson, W.D. (Sandia Labs., Livermore, Calif. (USA)). Nov 1975. Contract AT(29-1)-789. 27p. (CONF-751006—23). Dep. NTIS $5.00.

From International conference on radiation damage in metals; Gatlinburg, Tennessee, USA (5 Oct 1975).

The theory of trapping and diffusion of helium and hydrogen in metals is reviewed. The fundamental aspects of the behavior of these particles is emphasized and hence ab initio methods of calculation of interatomic potentials are described. In particular, two-body free-electron and Hartree-Fock calculations for closed shell systems are described and compared for an exam-

ple case, He-Cu$^+$. Helium defect aggregates studied using these potentials are reviewed and several previously unreported calculations of helium clustering in tungsten are given. A brief discussion of the quantum nature of the diffusion of light particles is also given. (auth)

6993 **Diffusion of iron ions in a cold liquid: evidence against a jump model.** Ruby, S.L.; Love, J.C.; Flinn, P.A.; Zabransky, B.J. (Argonne National Lab., IL). *Appl. Phys. Lett.*; 27: No. 6, 320-322(15 Sep 1975).

Macroscopic (x-ray attenuation) and microscopic (Moessbauer line broadening) measurements of ions diffusing in a cold liquid were taken. Combined, the results demonstrate that jumps the size of lattice dimensions do not take place, in contrast to crystalline diffusion. Surprisingly from molecular dynamical considerations, D is Arrhenius-like over four decades. 1 figure, 1 table (auth)

RADIATION EFFECTS

6994 (SAND—75-8222) **Absorption induced in fiber waveguides by low dose-rate electron and gamma-ray radiation.** Watkins, L.M. (Sandia Labs., Albuquerque, N.Mex. (USA)). Mar 1975. Contract AT(29-1)-789. 20p. Dep. NTIS $3.50.

Comprehensive measurements of absorption versus radiation dose and recovery versus time were performed in some optical fibers. Results show that the values of radiation-induced absorption are independent of dose rate from 5 x 10^2 to 6 x 10^6 rads/day for total doses to 6 x 10^4 rads. The fibers studied were Corning Low Loss, Schott UV, Crofon, Polystyrene Core, and Galileo K2-K irradiated with ^{60}Co gamma rays and ^{90}Sr beta particles. (auth)

CHEMISTRY

6995 (MLM—2241) **Mound Laboratory activities for the Division of Physical Research. Progress report, January—June 1975.** Fitzharris, R.E. (ed.). (Mound Lab., Miamisburg, Ohio (USA)). 11 Nov 1975. Contract E-33-1-GEN-53. 53p. Dep. NTIS $5.45.

Activities in research programs devoted to isotope preparation, properties of D_2 and He at low temperature, metal hydrides, separation chemistry, and separation research are reported. A separate abstract was prepared for each of the five areas of study. (JRD)

ANALYTICAL AND SEPARATIONS CHEMISTRY

6996 (ICP—1079) **Analytical Chemistry Branch annual report for fiscal year 1975.** Crawford, J.M. (Allied Chemical Corp., Idaho Falls, Idaho (USA). Idaho Chemical Programs - Operations Office). Oct 1975. Contract E(10-1)-1375. 151p. Dep. NTIS $7.60.

The Analytical Chemistry Branch Annual Report presents the non-routine, significant analytical services and supporting development work for FY-1975. The analytical and technical support activities for the Idaho Chemical Programs and other INEL and outside contractors include mass spectrometry, gas chromatography, atomic absorption spectrophotometry, emission spectrography, x-ray diffractometry, radiochemistry, spectrophotometry, titrimetry, gravimetry, coulometry, quality control, and remote techniques. Improvement of equipment, analytical techniques, and methods are a significant part of this report. In an appendix specific methods are given for the determination of Gd by x-ray fluorescence, spectrophotometric determination of nitrate with chromatropic acid, spectrophotometric determination of milligram amounts of U in samples containing Th, triisooctylamine extraction-fluorophotometric determination of U, separation of U for mass spectrometric analysis, and dissolution of HTGR coated fuel particles for the determination of U and Th. (JSR)

6997 (UCID—15644-75-2) **General Chemistry Division quarterly report, April—June 1975.** Harrar, J.E. (comp. and ed.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). 3 Sep 1975. Contract W-7405-Eng-48. 45p. Dep. NTIS $5.25.

The progress report is divided into four sections, each of which has been abstracted and indexed separately for NSA/ERA. (JGB)

6998 (UCID—15644-75-2, pp 1) **Analytical research and development for the Whitney Programs. Automation and instrumentation. Computer automation of the Cary Model 17I spectrophotometer.** Haugen, G.R.; Bystroff, R.I.; Downey, R.M.; Fisher, E.R.; Newton, J.C.; Richardson, J.H. 3 Sep 1975.

In General Chemistry Division quarterly report, April—June 1975.

In the area of automation and instrumentation, progress in the following studies is reported: computer automation of the Cary model 17I spectrophotometer; a new concept for monitoring the concentration of water in gases; on-line gas analysis for a gas circulation experiment; and count-rate-discriminator technique for measuring grain-boundary composition. In the area of analytical methodology and measurements, progress is reported in the following studies: separation of molecular species by radiation pressure; study of the vaporization of U(thd)$_4$, (thd = 2,2,6,6-tetramethylheptane-3,5-drone); study of the vaporization of U(C_8H_8)$_2$; determination of ethylenic unsaturation in polyimide resins; and, semimicrodetermination of hydroxyl and amino groups with pyromellitic dianhydride (PMDA). (JGB)

ACTIVATION AND NUCLEAR REACTION PROCEDURES

6999 (CONF-751009—4) **Elemental analysis of water and air solids by neutron activation analysis.** Bate, L.C.; Lindberg, S.E.; Andren, A.W. (Wisconsin Univ., Madison (USA). Water Chemistry Lab.). 1975. 16p. Dep. NTIS $4.50.

From International nuclear and atomic activation analysis conference; Gatlinburg, Tennessee, USA (14 Oct 1975).

Instrumental neutron activation analysis was used to determine the elemental concentrations in water and air solids samples collected on Nucleopore and Whatman filters from the Walker Branch Watershed. The results from this study show that the trace element concentrations removed by water from the watershed vary seasonally, as well as geographically. The data point up the usefulness and versatility of absolute neutron activation analysis. The NBS Standard Orchard Leaves were assayed in a similar manner, and good agreement was obtained between results here and standard values. (auth)

7000 (LBL—4000, pp 353-357) **Alasiya of the Amarna letters.** Artzy, M. (Hebrew Univ., Jerusalem); Asaro, F.; Perlman, I. Jul 1975.

In Nuclear chemistry. Annual report, 1974.

7001 (LBL—4000, pp 362-364) **Evidence in support of similar source material in the Genesis of alkalic basalts.** Bowman, H.R. (Univ. of California, Berkeley); Asaro, F.; Carmichael, I.S.E.; Mark, R.K.; Schmincke, H.U. Jul 1975.

In Nuclear chemistry. Annual report, 1974.

7002 (LBL—4000, pp 364-366) **Ocean ridge-like tholeiites in the northern Great Basin of Nevada.** Bowman, H.R. (Univ. of California, Los Angeles); Asaro, F.; Mark, R.K.; Hu, C.L.; McKee, E.H.; Coats, R.R. Jul 1975.

In Nuclear chemistry. Annual report, 1974.

7003 (LBL—4000, pp 366-367) **Rare earth and trace element patterns in historic Azorean lavas.** Bowman, H.R. (Ruhr Univ., Bochum, Ger.); Flowers, M.F.J.; Schmincke, H.U. Jul 1975.

In Nuclear chemistry. Annual report, 1974.

CHEMICAL PROCEDURES

7004 (BERC/RI—75/13) **Determination of C_1—C_4 hydrocarbons adsorbed on soils.** Wesson, T.C.; Armstrong, F.E. (Energy Research and Development Administration, Bartlesville, Okla. (USA). Bartlesville Energy Research Center). Dec 1975. 18p. Dep. NTIS $4.00.

During the past 45 years, scientists have been trying to establish correlation between soil gas hydrocarbons and possible oil and gas deposits beneath. Many methods have been devised over the years for extracting and analyzing these gases. An adaptation of one of the more promising methods was developed and evaluated at the Bartlesville (Okla.) Energy Research Center. The method is basically a hydrochloric acid extraction/water displacement procedure with the final recovered gas analyzed by gas chromatography. From the gas chromatographic data, the relative concentration levels of the C_1-C_4 paraffin gases in the soil can be determined. Procedures are described in detail. Reagent contamination difficulties are discussed. (auth)

7005 (UCID—16966) **Determination of neptunium in a U—0.5% Np alloy by controlled-potential coulometry.** Magana, J.W.; Walden, J.C.; Harrar, J.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 18 Nov 1975. 9p. Dep. NTIS $4.50.

A published procedure for the determination of neptunium in uranium-neptunium alloys has been checked and applied to the analysis of U-0.5 percent Np alloys. Both the accuracy and precision of the method are within a few percent, and no separations are required. After set-up, no standard solutions are required for long-term reliability. After sample dissolution, the time required for analytical measurement is approximately 30 minutes. (auth)

7006 (UCRL—51964) **Continued studies of calorimeter performance at the Lawrence Livermore Laboratory.** Steward, S.A.; Tsugawa, R.T. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 17 Nov 1975. Contract W-7405-Eng-48. 16p. Dep. NTIS $4.00.

Calibrations of two calorimeters used for tritium and plutonium assays were made. Data from three new standards of about 0.5, 1, and 5 W were added to the results of a previous report and analyzed together. The accuracies of both calorimeters appear to fall within the specified 0.5 percent, although the data now available for the large calorimeter is insufficient to permit a more definite conclusion. An expression of the bias correction for each calorimeter with respect to the sample power cannot be determined. The bias of the medium thermopile-type calorimeter tends to be positive, however, and that of the large resistance-bridge design appears to be negative. (auth)

7007 Studies on the hydrolysis of metal ions. LXII. The plutonyl ion in sodium perchlorate medium. Schedin, U. (Kungliga Tekniska Hoegskolan, Stockholm). *Acta Chem. Scand., Ser. A;* **29**: No. 3, 333-334(1975).

The hydrolysis equilibria of plutonyl ion in 3 M $(Na)ClO_4$ have been studied at 25°C using a glass electrode. The concentration range for PuO_2^{2+} (B) was 10-150 mM and the average number of ligands, OH^-, bound per PuO_2^{2+} (Z) was 0-1.3. Fresh Pu(VI) solutions were always used, in which the concentration of other plutonium ions was less than one per cent. About 20 species (p,q) = (PuO_2)/sub q/(OH)/sub p//sup (2q-p) + were tried in the LETAGROP species selector. For $Z < 0.3$, where the attainment of chemical equilibria could be proved by back titrations, all the data could be explained by (2,2), with the "best" equilibrium constant $\log {}^*\beta_{2,2} = -8.24 +- 0.01$, where ${}^*\beta$/sub p,q/ is the equilibrium constant for $qPuO_2^{2+} + pH_2O$ in equilibrium (PuO_2)/sub q/(OH)/sub p//sup (2q-p)+/+ pH^+. For higher Z the data are uncertain as equilibrium could not be proved. The best fit is given by (2,2) and (7,4) with the equilibrium constant ${}^*\beta_{2,2} = -8.23 +- 0.04$ and $({}^*\beta_{7,4} = -29.13 +- 0.04)$. A short survey is also given of some properties of plutonium ions in aqueous solutions, as they might have affected this investigation. (auth)

RADIOMETRIC AND RADIOCHEMICAL PROCEDURES

7008 (CONF-741040—P1, pp 189-202) **Trace element studies in bioenvironmental samples using 3-MeV protons.** Walter, R.L. (Duke Univ., Durham, NC); Willis, R.D.; Gutknecht, W.F. 1974.

From 3. conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In Proceedings of the third conference on application of small accelerators. Volume I. The use of small accelerators in research and teaching.

Trace metal compositions of a wide range of biological, environmental, medical and clinical samples were investigated using proton-induced x-ray emission analysis (PIXEA). The x-rays were detected with a Si(Li) detector and spectra from over 3000 irradiations have been recorded on magnetic tape. The chi^2 fitting code TRACE developed at our laboratory was used in a semi-automatic mode to extract abundances of elements from S to Cd. Various methods of overcoming analytical problems and specimen preparation difficulties are reported. Results from some samples for typical studies are illustrated along with the reasons for interest in the sample types. (auth)

7009 (HW—44922) **Autoradiographic analysis of plutonium deposition in human skin.** Dockum, N.L.; Case, A.C. (Hanford Works, Richland, Wash. (USA)). 23 Aug 1956. 7p. Dep. NTIS $4.50.

A human skin biopsy known to contain a quantity of plutonium was submitted for autoradiographic analysis. The deposition of the plutonium may have occurred following puncture of the dorsum of the skin in the area between the right thumb and index finger. The puncture occurred on February 28, 1952 and the skin was excised on July 31, 1956. A description is given of the autoradiographic technique employed to locate the site of deposition, the nature of the plutonium (particulate or diffuse), and the quantity of plutonium found as determined by radioanalysis of the skin biopsy. (auth)

7010 (ORO—4205-1) **Radioisotope x-ray emission spectrometry for multielement analysis of air particulates. Final report, June 1971—March 1975.** Rhodes, J.R.; Pradzynski, A.H.; Sieberg, R.D. (Columbia Scientific Industries, Austin, Tex. (USA). Applied Research Div.). Jun 1975. Contract AT(40-1)-4205. 107p. Dep. NTIS $8.50.

Progress over the past four years to develop, apply, and establish the technique of radioisotope-excited, energy-dispersive x-ray emission spectrometry for multielement analysis of air particulates collected on filters is described. All the work has been assembled in fifteen papers or specifications which are included as appendices to this report. These appendices cover technique development (3 papers), instrumentation and applications (7), standards and interlaboratory comparisons (3) and reviews (2). The body of the report consists of a chronology of the project. (auth)

7011 Method and apparatus for measuring incombustible content of coal mine dust using gamma-ray backscatter. Armstrong, F.E. (to U.S. Energy Research and Development Administration). US Patent Application 550,099. Filed date 14 Feb 1975. 21p.

This invention describes the method and apparatus for measuring incombustible content of particulate material, particularly coal mine dust. It involves placing a sample of the particulate material in a container to define a pair of angularly oriented surfaces of the sample, directing an incident gamma-ray beam from a radiation source at one surface of the sample and detecting gamma-ray backscatter from the other surface of the sample with a radiation detector having an output operating a display to indicate incombustible content of the sample. The positioning of the source and detector along different surfaces of the sample permits the depth of the scattering volume defined by intersection of the incident beam and a detection cone from the detector to be selected such that variations in scattered radiation produced by variations in density of the sample are compensated by variations in the attenuation of the incident beam and the gamma-ray backscatter. (auth)

7012 (BNWL-tr—159) **Radioactive emissions from power plant facilities fired with Rhineland lignite.** Kirchner, H.; Merz, E.; Schiffers, A. Translated from *Braunkohle;* No. 11, 340-345(Nov 1974). 16p. Dep. NTIS $4.50.

Radiochemical measurements were made on the trace content of U and Th in Rhenanian lignite samples and their ashes. Values were found to fluctuate considerably within certain limits. Measured Th values varied from 0.4 ppM to 2.7 ppM, with an average of approximately 1.1 ppM. U varied from 0.2 ppM to rare maximum values of 1.4 ppM, with average values around 0.4 ppM. The U and Th content of ash residues was somewhat lower than expected. A rough comparison of radioactive gaseous emissions of different types of power plants is given. (JGB)

7013 Surface analysis by low energy ion scattering spectroscopy and secondary ion mass spectroscopy. Nelson, G.C. (Sandia Labs., Albuquerque, NM). pp 364-373 of In Materials review '75. Azusa, CA; Society for the Advancement of Material and Process Engineering (1975).

From 7. national SAMPE technical conference; Albuquerque, New Mexico, USA (14 Oct 1975).

See CONF-751005—.

The surface sensitive techniques of ion scattering spectroscopy and secondary ion mass spectrometry provide information about the atomic mass of atoms present on a solid surface. The principles of these techniques are reviewed and their complementary nature is demonstrated. (auth)

7014 Activated phosphors having matrices of yttrium-transition metal compound. De Kalb, E.L.; Fassel, V.A. (to U.S. Energy Research and Development Administration). US Patent 3,893,939. 8 Jul 1975. Filed date 4 Jan 1973. 6p.

PAT-APPL-321,064.

A method is described for preparing a phosphor composition containing a lanthanide activator element with a host matrix having a transition element as a major component. The host matrix is composed of certain rare earth phosphates or vanadates such as YPO_4 with a portion of the rare earth replaced with one or more of the transition elements. On x-ray or other electromagnetic excitation, trace lanthanide impurities or additives within the phosphor are spectrometrically determined from their characteristic luminescence. (auth)

SPECTRAL PROCEDURES

7015 (FRNC-TH—555) **Determination of the fine structure in the ionization plots obtained from a mass spectrometer with a large energy dispersion.** Deruaz, D. (Lyon-1 Univ., 69 (France)). 1974. 178p. (In French). INIS.

The precise determination of ionization potentials, fragment ion appearance potentials and different excited state levels of the positive ions formed, together with phenomena due to an electron impact, were studied from ionization efficiency curves obtained by mass spectrometry. A standard ion source and an analytical method of electron energy dispersion reduction were used to study fine structures of ionization efficiency curves. Before each set of measurements the scattering was determined by calculation of the second derivative of a logistic function deduced from the cubic regression of the experimental helium function ionization efficiency curve values. For each series of recordings the numerical values were processed by a computer to raise by twenty the signal to noise ratio and calculate the ionization efficiency curve values by the energy difference method and the iterative unfolding method. In order to judge the reliability of the technique the ionization potentials of a set of eleven complex molecules were determined and compared with the results obtained by photoionization and photoelectron spectrometry. (FR)

7016 (GA-A—13536) **Analytical Chemistry Department, annual report, 1974.** (General Atomic Co., San Diego, Calif. (USA)). 27 Oct 1975. Contract E(04-3)-167. 49p. Dep. NTIS $5.45.

Progress is reported in the following areas of research most of which is related to the analysis of HTGR materials: gamma ray spectroscopy and radiochemistry; HTGR fuel reprocessing support; HTGR fuel manufacturing support; resin kernel program; doped fuel kernel program; TRIGA fuel fabrication support; and, miscellaneous procedures. (JGB)

7017 (KAPL-P—4040) **Empirical quantitation procedures in SIMS.** McHugh, J.A. (Knolls Atomic Power Lab., Schenectady, N.Y. (USA)). 1975. 6p. (CONF-751054—2). Dep. NTIS $4.50.

From Mass spec seminar; Honolulu, Hawaii, USA (13 Oct 1975).

Quantitation of SIMS (secondary-ion mass spectrography) should be based on relative ion yields and on an empirical method. The basis of a useful empirical method is listed and the relative elemental sensitivity factor defined. Resulting accuracy is discussed. (DLC)

7018 (UCID—15644-75-2, pp 29) **Special projects. Automation of a mass spectrometer for the National Center for Toxicological Research (NCTR).** Newton, J.C.; Brand, H.R.; Bystroff, R.I.; Elliott, J.R.; Pomernacki, C.L. 3 Sep 1975.

In General Chemistry Division quarterly report, April—June 1975.

Progress is reported in the following studies: automation of a mass spectrometer for the national center for toxicological research (NCTR); automation of the Davies-Gray/New Brunswick Laboratory method for the determination of U; real-time materials control in a nuclear fuel plant; simulation modeling of mixed-oxide fuel-rod fabrication plants; pilot, laboratory-automation project with the National Environmental Research Center, Cincinnati, Ohio; thallium in human erythrocyte membranes; an x-ray photoelectron spectroscopy study; ESCA study of sulfur-bearing particulates; and chemical and statistical analysis of an inventory of precious metal at the LLL metal finishing shop. (JGB)

7019 (UCRL—76956) **Detector system for in-situ spectrometric analysis of ^{241}Am and Pu in soil.** Kirby, J.A.; Anspaugh, L.R.; Phelps, P.L.; Amantrout, G.A.; Sawyer, D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1975. Contract W-7405-Eng-48. 9p. (CONF-751116—12). Dep. NTIS $4.50.

From Nuclear science symposium; San Francisco, California, USA (17 Nov 1975).

This system for quantitative analysis of Pu in soil via ^{241}Am has four 2.5-mm high-purity Ge detectors of 33 cm^2 total detecting surface area. These detectors are paralleled by gating circuitry to avoid the degradation of energy resolution associated with electronic output summing. In field tests the system was approximately three times as sensitive as a 70-cm^3 Ge(Li) detector and approximately an order of magnitude more sensitive than the FIDLER system. (auth)

7020 **Mass spectral intensities of inorganic fluorine-containing compounds.** Beattie, W.H. (Los Alamos Scientific Lab., NM). *Appl. Spectrosc.*; **29**: No. 4, 334-337(1975).

Mass spectral intensities and sensitivities of 24 fluorine-containing gases and vapors have been measured on a time-of-flight mass spectrometer at an ionizing voltage of 70 eV. Apparatus and techniques for handling fluorine compounds are described. The relative sensitivities and relative abundances are tabulated for the following gases: BF_3, BrF_5, CF_4, CF_2Cl, CF_2Cl_2, CF_3I, C_2F_4, C_2F_6, ClF, ClF_3, F_2, HF, IF_5, IF_7, MoF_6, NF_3, N_2F_4, PF_3, SF_4, SF_6, SO_2F_2, SiF_4, UF_6, and XeF_4.

7021 **Analyzing organics in dilute aqueous solutions.** Jolley, R.L. (Oak Ridge National Lab., TN); Katz, S.; Mrochek, J.E.; Pitts, W.W. Jr.; Rainey, W.T. *Chem. Technol.*; **5**: 312-318(May 1975).

An integrated multiple-analytical identification procedure was developed and successfully applied on a routine basis for the separation and identification of stable organic compounds present at microgram-per-liter concentrations in complex aqueous mixtures. By use of this methodology, 36 organics were identified in the effluents from a domestic sanitary primary sewage treatment plant. Of these, 23 were quantified at 2- to 190-μg/l levels. Nine organics were identified, and eight were quantified at 5- to 90-μg/l levels in one sample of effluent from a domestic sanitary secondary sewage treatment plant. (auth)

SEPARATION PROCEDURES

7022 (JUL-Conf—13, pp 471-499) **Present status of enantiomeric analysis by gas chromatography.** Gil-Av, E. Nov 1974.

From International symposium on generation and amplification of asymmetry in chemical systems; Julich, F.R. Germany (24 Sep 1973).

In International symposium on generation and amplification of asymmetry in chemical systems.

There are two possible approaches for separating enantiomers by gas chromatography. One is based on the formation of diastereomeric derivatives. The handedness required for resolution is introduced covalently into the optically active molecules. The second alternative, where the handedness needed for resolution is provided by an optically active environment in the phase and not introduced covalently into the molecules to be separated, is discussed and experimental results are reviewed. (LK)

7023 (MLM—2241, pp 26-40) **Separation chemistry.** 11 Nov 1975.

In Mound Laboratory activities for the Division of Physical Research. Progress report, January—June 1975.

A method of preparing nitric acid solutions of iridium by fusion of the iridium in a KOH/KNO_3 mixture followed by dissolution of the fused iridium in nitric acid is described. The method may be adaptable to the separation of plutonium from iridium and suitable for decontaminating massive iridium. Process analytical data on 30 batches of Cotter Concentrate (approximately three drums) showed recovery of about 70 g of thorium 230 with 90 percent recovery efficiency. The behavior of the bone char/water system at pH 10 is being examined, and it has been found that bone char imposes low potentials on water at about pH 10. The behavior of hexavalent plutonium with bone char at pH 10 was also examined. The removal of uranium from waste streams by contact with bone char was studied along with the mechanism which involves the reduction of uranium in solution to ultra low levels. Experimental studies were initiated wherein an adsorption isotherm, involving the ^{234}U bone char system, was measured. A total of 20.73 mg of ^{229}Th has been separated from aged ^{233}U. In addition, 1.63 mg ^{229}Th was separated from ^{233}U that has been previously processed. Processing of solutions A13-B and A13-B2 was completed through the three separation stages. The uranium was precipitated from the final solutions and calcined to the oxide. The total oxide weight of this product, designated A13-2, is 22.285 g. When all analyses have been completed and the weight of ^{234}U calculated, the product will be shipped. (auth)

7024 **Low temperature, low pressure hydrogen gettering.** Anderson, D.R.; Courtney, R.L.; Harrah, L.A. (to U.S. Energy Research and Development Administration). US Patent 3,896,042. 22 Jul 1975. Filed date 15 Feb 1974. 10p.

PAT-APPL-443,077.

A system is described for the gettering of hydrogen and its isotopes. The gettering materials are painted or coated onto, or otherwise disposed in an area or volume from which hydrogen is to be removed. (auth)

INORGANIC AND PHYSICAL CHEMISTRY

7025 (UCID—16933) **Basic principles of chemistry and physical chemistry.** Colmenares, C.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 13 Oct 1975. Contract W-7405-Eng-48. 242p. Dep. NTIS $7.60.

A course designed to provide communications between the designer of a system such as a mechanical engineer or a physicist and the material scientist such as a chemist or chemical engineer is presented. The topics discussed are stoichiometric principles, behavior of ideal gases, vapor pressure, humidity and saturation, solubility of gases in liquids, diffusion of gases, chemical reaction kinetics, and application of concepts to compatibility problems.

The appendix provides problems to be used in conjunction with TV lectures. (JSR)

CHEMICAL AND PHYSICOCHEMICAL PROPERTIES

7026 (FRNC-TH—552) **Relaxation in high resolution nuclear magnetic resonance. Application to studying molecular motions in liquid media.** Briguet, A. (Lyon-1 Univ., 69 (France)). 1974. 198p. (In French). INIS.

isotopic shift with ^{13}C, ^{29}Si, ^{77}Se; relaxation in chloroform, bromoform, trichlorosilane and phenyl-selenol.

High-resolution relaxation measurements were carried out in order to obtain information on molecular movements in liquids. This was achieved by the development of pulsed methods based on audiofrequency modulation, whereby relaxation can be studied selectively on a continuous wave spectrometer. With the instruments built it was possible to measure T_1 and T_2 and to carry out transitory Overhauser effect experiments and homonuclear and heteronuclear decoupling. The coupling of hydrogen with scarce isotopes ^{13}C, ^{29}Si, ^{77}Se was turned to account for studies on isotopic satellites of very low intensity. Owing to the possibilities offered by the isotopic effect and by the measurement facilities the contribution of a given relaxation mechanism was reckoned for a few suitably chosen molecules. The reorientation movement correlation times were determined for chloroform, bromoform, trichlorosilane and phenyl selenol. In the case of trichlorosilane the study was fine enough to give the correlation times associated with movements around the main axes of the inertia tensor. (FR)

7027 (FRNC-TH—556) **Hertzian spectroscopy application to excited states in accelerated ion beams.** Gaillard, M.L. (Lyon-1 Univ., 69 (France)). 1974. 256p. (In French). INIS.

Accelerated ion beams enables the application of optical hertzian spectrometry methods to be extended to research on the excited states of free ionic systems. The photon beat method has proved especially simple to apply in beam foil geometry because of the unidirectional beam velocity while the beam gas device is suitable for experiments of the energy level crossing type. Only the resonance technique involving direct application of high-frequency magnetic fields poses serious problems because of the high HF powers necessary. So far structure intervals have been measured in ions carrying up to three charges (seven in the special case of Lamb shift measurements) with a precision of a few percent. Study of hydrogen-like or helium-like ions of high Z allows the fundamental calculations of quantum electrodynamics to be checked with regard to the Lamb shift or the spontaneous emission theory. In more complex electronic systems, optical spectroscopy of accelerated ion beams gives wavelengths with a resolution reaching 10^{-5}, lifetimes with an accuracy better than 10% when the cascade effects are properly studied, and Lande factors with a precision of several % under present technical conditions. The photon beat method concerns hyperfine nuclear effects in light atoms of $Z <= 20$. (FR)

7028 (IS-T—688) **Synthesis and characterization of metal—metal bonded dimers of tantalum and tungsten.** Templeton, J.L. (Ames Lab., Iowa (USA)). Dec 1975. Contract W-7405-eng-82. 218p. Dep. NTIS $8.75.

Thesis.

A search for innovative synthetic routes to new metal-metal bonded metal-halide clusters resulted in isolation of two completely independent dimeric species. The syntheses and characterizations of $Ta_2X_6(SC_4H_8)_3$ (X = Cl, Br) and $[(n\text{-}C_3H_7)_4N]_2[W_2Br_8]$ followed entirely different experimental routes, yet occasionally similar properties linked the two projects. (auth)

7029 (JUL-Conf—13, pp 149-175) **Five simultaneous steady states in a flipping two-compartment-system with optical antipodes.** Seelig, F.F.; Zielke, R. (Univ., Tuebingen, Ger.). Nov 1974.

From International symposium on generation and amplification of asymmetry in chemical systems; Julich, F.R. Germany (24 Sep 1973).

In International symposium on generation and amplification of asymmetry in chemical systems.

The previously given systems-theoretic model for the synthesis of optical antipodes (A/sup D/ and A/sup L/) in strongly asymmetric yield, which shows mono- or bistable behavior depending on the degree of "openess" of the chemical reaction system is reconsidered for two equal compartments. (auth)

7030 (LBL—3712) **Oxygen-17 nuclear magnetic resonance studies of the second coordination sphere of chromium(III) in aqueous solution.** Earl, W.L. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1975. Contract W-7405-ENG-48. 94p. Dep. NTIS $5.00.

Thesis.

The oxygen-17 bulk water relaxation times and chemical shifts have been measured at 8 MHz on several aqueous solutions of $Cr(H_2O)_6^{3+}$ and on a solution of $CrF(H_2O)_5^{2+}$. Analysis of the NMR data has yielded the average lifetime of water molecules in the second coordination sphere. Further, the data have been analyzed to yield the relative contributions of each NMR relaxation mechanism to the overall relaxation. The average lifetime of water molecules in the second coordination sphere of $Cr(H_2O)_6^{3+}$ has been calculated at 298°K to be 1.0×10^{-10} sec. The activation parameters are: $\Delta H^{++} = 2.8$ kcal and $\Delta S^{++} = -0.8$ eu. A few measurements were made on a sample of $CrF(H_2O)_5^{2+}$. From these data it was concluded that the average lifetime for water molecules in the second coordination sphere of $CrF(H_2O)_5^{2+}$ is not greatly different from the lifetime of water in the second coordination sphere of $Cr(H_2O)_6^{3+}$. These lifetimes are longer than the calculated lifetime for self diffusion in water and consequently are thought to reflect the electrostatic attraction between the charge on the Cr(III) and the dipole of the water molecules. (auth)

7031 (MLM—2241, pp 13-14) **Low temperature research.** 11 Nov 1975.

In Mound Laboratory activities for the Division of Physical Research. Progress report, January—June 1975.

Several liters of e-D_2 have been made for the ortho-para D_2 vapor pressure experiments. Two new cryostats are being designed and fabricated, one for tritium studies and one for low temperature differential calorimetry. A review of the superfluid properties of ^3He has been prepared and will be published as a topical report. (auth)

7032 (MLM—2241, pp 15-25) **Metal hydride research.** 11 Nov 1975.

In Mound Laboratory activities for the Division of Physical Research. Progress report, January—June 1975.

Computer programs have been developed to calculate electronic properties of transition metals and their hydrides. The programs can be used to predict such properties as crystalline stability, electronic resistivity, Fermi surfaces, bulk moduli (or compressibilities), and hydrogen coordination of the metal atoms. Such information is of fundamental importance in understanding the electronic processes which occur in transition metals and their hydrides. Detailed calculations have been performed for Li and LiH, to test the computational integrity of the programs, and of the local density exchange approximation to the Hartree—Fock exchange. Initial work on NiH has also been performed. The proton spin-lattice relaxation times T_1 have been measured as a function of temperature and frequency for a sample of $VH_{0.53}$. The experimental values for the T_1 minimums are approximately twice as large as the minimum values calculated using the BPP model. The activation for proton diffusion in the β-phase of VH/sub x/ is estimated to be 0.21 +- 0.01 eV. Preliminary NMR studies have been performed on $FeTiH_{1\text{-}1}$ (β-phase) and $FeTiH_{1\text{-}7}$ (γ-phase). The nuclear relaxation times at room temperature indicate the NMR spectra are inhomogeneously broadened and proton diffusion is not rapid enough to greatly affect either T_1 or T_2. (auth)

7033 (UCRL—50028-75-3) **H-Division quarterly report, July—September 1975.** (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1975. Contract W-7405-Eng-48. 57p. Dep. NTIS $5.45.

The following are reported: shock Hugoniots of atomic iodine; electron screening corrections to the dense plasma equation of state (EOS); EOS of the Lennard—Jones fluid; test of polystyrene EOS; flexible EOS for nonionized fluids, computer code development, EOS for Ta and liquid transition metals; lateral refracton velocity in shocked iron; heat capacity, resistivity, and EOS of lead; shock compressibilities of lead and iron; tamped impulse (blowoff); impact of penetrators on armor and targets; various calculations in solid mechanics; shallow earth penetrators; simulation of combustion processes; brittle crack propagation; and spaced-charge development. (DLC)

7034 (UCRL-Trans—10974) **Determination of reaction-kinetic parameters from nonisothermal measurements.** Van Heek, K.H.; Juentgen, J. Translated from *Ber. Bunsenges. Phys. Chem.*; **72**: No. 9-10, 9-10(1968). 24p. Dep. NTIS $3.50.

A survey is given of the evaluation of nonisothermal measurements of the reaction rates of physical and chemical processes. There are various computational methods for calculating the reaction order, activation energy, and frequency factor, which are explained and compared with one another. The applicability of the individual methods is examined critically for five different reactions. (auth)

7035 (RFP-Trans—173) **Chemistry of carbon dioxide gas.** Kobayashi, M.; Inoue, S. Translated from **28**: No. 11, 942-951(1973). 17p. Dep. NTIS $4.50.

A review is presented on the fixation of atmospheric CO_2. Particular attention is given to the reaction of CO_2 with organometallic compounds and its biochemical fixation. 62 references. (JSR)

7036 (RFP-Trans—176) **Qualitative regularities of the interaction of carbon dioxide with sodium alcoholates.** Chirkina, G.D.; Nazarova, V.N. Translated from *Izv. Vyssh. Uchebn. Zaved., Khim. Khim. Tekhnol.*; **16**: No. 3, 398-401(1973). 4p. Dep. NTIS $4.25.

The qualitative regularities in the reaction of sodium alcoholates and carbon dioxide were investigated using the constant stream and competing reaction methods. Measurements of the relative rates of reaction of alcoholates with carbon dioxide reflect to a greater degree the solvation effects in mixtures of alcohols than the reactivity of carbon dioxide.

7037 **Factor group analysis for some molecules of interest in planetary atmospheres.** Ferraro, J.R. (Argonne National Lab., IL). *Appl. Spectrosc.*; **29**: No. 4, 354-355(1975).

The solid state selection rules for the k = 0 portion of the Brillouin zone were tabulated for a number of frosts of interest to planetary scientists. (JSR)

7038 **Effect of reagent vibrational energy on measured reaction rate constants.** Birely, J.H. (Aerospace Corp., El Segundo, CA); Lyman, J.L. *J. Photochem.*; **4**: 269-280(1975).

The effect of reagent vibrational energy E/sub vib/ on experimentally measured rate constants for reactions between neutral species at thermal kinetic energies is reviewed. The vibrational acceleration of chemical reactions has recently been characterized by a parameter α describing the efficiency of the usage of the internal energy in overcoming the Arrhenius activation energy, E/sub a/. For reactions of vibrationally excited H_2, HCl, OH, and O_3 studied to date, α is generally less than 0.6, and is uncorrelated with E/sub a/, E/sub vib/, the excess vibrational energy, or the reaction exothermicity. It is concluded that the utility of this conversion efficiency parameter is limited to the phenomenological description of the vibrational accceleration of rate processes or to the role of an adjustable parameter in calculations involving reactions of excited species. (auth)

7039 **Kinetics of association reactions pertaining to H_2SO_4 aerosol formation.** Castleman, A.W. Jr.; Davis, R.E.; Munkelwitz, H.R.; Tang, I.N.; Wood, W.P. (Brookhaven National Lab., Upton, NY). pp 629-640 of In Chemical kinetics data for the upper and lower atmosphere. New York; John Wiley and Sons, Inc. (1975).

The rates of oxidation of SO_2 by OH were measured at room temperature by performing steady-state photolysis of mixtures of H_2O, SO_2, and CO in N_2. At a total pressure of 760 torr, the pseudo-second-order rate constant by 6.0×10^{-13} cm^3 $molec^{-1}$ s^{-1}. With nitrogen as the third body, and at pressures less than 20 torr, the third-order rate constant was found to be 1.6×10^{-31} cm^6 $molec^{-2}$ s^{-1}. Separate experiments, employing fast-flow techniques, were conducted to determine the rate of reaction of SO_3 with H_2O. At room temperature and total pressures ranging from 1.0 to 1.3 torr, a value of 9.1×10^{-13} cm^3 $molec^{-1}$ s^{-1} was obtained. These measured rate constants, along with the requisite atmospheric concentration data currently available in the literature, were used to assess the possibility of gas phase conversion of SO_2 to sulfuric acid aerosols. It was concluded that under some conditions new aerosols could form in both the troposphere and the stratosphere. (auth)

7040 **Temperature-dependent absorption spectrum of the ν_3 band of SF_6 at 10.6 μm.** Nowak, A.V.; Lyman, J.L. (Los Alamos Scientific Lab., NM). *J. Quant. Spectrosc. Radiat. Transfer*; **15**: No. 10, 945-961(1975).

Mixtures of SF_6 diluted by argon were heated behind an incident shock front in the range 400 to 1500K. Absorption measurements at 11 wavelengths near 10.6 μm were made on the post-shock, equilibrated gas using a CO_2 laser. A band contour model, which makes use of known spectroscopic constants and the experimental results, satisfactorily accounts for the observed temperature dependence of the absorption coefficient. We are able to estimate the identity of the transitions responsible for absorption of the laser radiation. (auth)

7041 **Vibrational spectra of solid and molten phases of the alkali metal tetrafluoroborates.** Bates, J.B.; Quist, A.S. (Oak Ridge National Lab., TN). *Spectrochim. Acta, Part A*; **31A**: 1317-1327(1975).

Raman and ir spectra of the low temperature (orthorhombic) and high temperature (cubic) solid phases of KBF_4, $RbBF_4$, and $CsBF_4$ were measured, and Raman spectra of the molten salts (including $LiBF_4$) were observed. Studies of the low temperature phase include a determination of the longitudinal optical mode frequencies of the ν_3 mode by polarized specular reflectance ir spectroscopy. The frequency shift observed for the Raman active component of ν_1 in crystalline lithium, sodium, potassium, rubidium, and cesium fluoroborates is interpreted in terms of a model based on an isolated BF_4-ion contained in a static field. (auth)

7042 **High-pressure phase transformation of $CaSO_4$ (anhydrite) during a nuclear explosion.** Khan, J.S. (Univ. of California, Livermore). *Science*; **189**: No. 4201, 454-455(8 Aug 1975).

Examination of the postshot cores from the portion of the Tatum Salt Dome that had been subjected to a nuclear explosion (Salmon Event) has indicated evidence for the high-pressure phase transformation of anhydrite. This evidence consists of distinctly different optical domains within the shocked anhydrite. Evidence for the transition exists out to approximately 1.5 cavity radii. Excellent agreement exists between experimental work and the theoretical calculations of the predicted pressure profile. (auth)

ISOTOPE EFFECTS

7043 **Deuteron and proton magnetic resonance studies of $AlCl_3.6D_2O$ and $AlCl_3.6H_2O$** . El Saffar, Z.M.; Peterson, E.M. (DePaul University, Chicago, Illinois 60614). *J. Chem. Phys.*; **63**: No. 10, 4474-4478(15 Nov 1975).

The angular dependence of the deuteron magnetic resonance line splittings recorded in one plane of rotation of a single crystal of $AlCl_3 . 6D_2O$ have been used to establish the quadrupole coupling tensor and determine the deuteron positional coordinates. These coordinates are found to be 0.073, 0.187, 0.143; 0.202, 0.204, and 0.087. Proton relaxation times in polycrystalline $AlCl_3 . 6H_2O$ have been measured as a function of temperature to evaluate the dynamic parameters associated with molecular motion. Twofold motion of H_2O with an activation energy of 10.0 + or - 0.5 kcal/mole is found to dominate the relaxation process below 385°K. A second motion with an activation energy of 17.0 + or - 1.0 kcal/mole appears above 385°K and is likely to be translational diffusion of the water molecules. (AIP)

ISOTOPE EXCHANGE AND ISOTOPE SEPARATION

7044 (IS-T—704) **Reactions of sigma-bonded organochromium(III)complexes.** Leslie, J.P. II. (Ames Lab., Iowa (USA)). Dec 1975. Contract W-7405-eng-82. 205p. Dep. NTIS $8.75.

Thesis.

Three projects were carried out, each dealing with the kinetics and mechanism of reactions of sigma-bonded organochromium(III) complexes of the form $(H_2O)_5CrR^{2+}$. Part I describes the kinetics of the reaction of dichloromethylchromium(III) ion with chromium(II) ion in aqueous acid. Part II deals with the radioexchange of 4-pyridinomethylchromium(III) ion with $^{51}Cr^{2+}$ and the kinetics of formation of the organochromium species at 55° in 1 M H^+. Part III deals with the reactions of Hg^{2+} and CH_3Hg^+ with a series of $(H_2O)_5CrR^{2+}$ complexes, in which R is an aliphatic alkyl group, a haloalkyl group, or an aralkyl group. (LK)

7045 (MLM—2241, pp 11-12) **Isotope separation.** 11 Nov 1975.

In Mound Laboratory activities for the Division of Physical Research. Progress report, January—June 1975.

Enrichment operations are reported for ^{36}Ar, ^{38}Ar, ^{13}C in methane, ^{78}Kr, ^{82}Kr, ^{83}Kr, ^{21}Ne, ^{22}Ne, ^{20}Ne, ^{124}Xe, ^{136}Xe, and ^{131}Xe. (JRD)

7046 (MLM—2241, pp 41-50) **Separation research.** 11 Nov 1975.

In Mound Laboratory activities for the Division of Physical Research. Progress report, January—June 1975.

A total reflux operation was achieved in a prototype chemical exchange system for enrichment of calcium isotopes using a Karr reciprocating-plate counter current extraction column. Sulfur 34 (natural abundance, 4.2 percent) was enriched to a concentration greater than 90 percent in a 12-column liquid thermal diffusion system. Carbon disulfide is used as the working fluid. A computer program was developed to calculate the transient performance of the dual cascade system. Total scattering cross sections for the argon-krypton scattering pair were measured. Tests are being conducted on the quadrupole detector, and performance has been improved considerably by replacing the rotating chopper wheel with a tuning fork chopper. Quantum mechanical calculations for the thermal diffusion factor of an equimolar $^3He—^4He$ mixture are presented for a new hybrid Morse-V/sub DD/ potential by Bruch and McGee and also for a potential derived from molecular beam scattering results. Neither of these potentials represents the 2 to 5°K experimental results as well as the original hybrid Morse-V/sub DD/ potential by Bruch and McGee. Theoretical values of the thermal diffusion factor for $^{124}Xe—^{136}Xe$ were computed using a new xenon potential proposed by Barker and co-

workers. These values agree with the experimentally determined values of α/sub T/ for xenon better than values obtained with any other potential investigated. Also, this potential can be used to predict many other physical properties of xenon. (auth)

7047 (UCRL-Trans—10738) **Study of the photochemical oxidation of mercury: application to the separation of mercury isotopes.** Morand, J.P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Mar 1974. Translation of CEA-R—4126. 95p. Dep. NTIS $6.00.

Investigation of the mechanism of the isotopic photo-oxidation of mercury has enabled the existence of an unstable excited complex (HgO_2*) to be demonstrated. In the presence of butadiene, this complex gives stable mercuric oxide. Butadiene does not act purely as an interceptor for oxidizing species. By theoretical investigation of the complex HgO_2*, its electronic structure ($^3\Pi$) could be determined and its energy of formation (4.6 eV) predicted. The phenomenon of photodecomposition of mercuric oxide was demonstrated and its importance evaluated. The results obtained made it possible to develop an apparatus for the photochemical separation of the isotopes of mercury, whose efficiency is acceptable despite the low quantum yield. Since the method for the photochemical separation of the isotopes has only been studied for mercury, an identical study for other elements, and particularly for elements of the same group as mercury (zinc, cadmium), could lead in the future to new aspects in the study of photochemical mechanisms. (auth)

7048 (LA-tr—75-41) **Laser stimulated chemical reactions and isotope separation.** Basov, N.G.; Belenov, E.M.; Isakov, V.A.; Markin, E.P.; Orevskii, A.N.; Romanenko, V.I.; Ferapontov, N.B. Translated by A.D. Cernicek from *Kvantovaya Elektron. (Moscow)*; **2**: 938-945(1975). 27p. Dep. NTIS $5.00.

This study examines a method of isotope separation in chemical reactions stimulated by laser excitation in the infrared range. It is shown that anharmonicity of molecular vibration exerts practically no effect on the coefficient of isotope separation. Nitrogen isotope separation in a laser-stimulated reaction $N_2 + O_2$ yields 2NO is obtained. The reaction was stimulated in a vessel containing air by simultaneous excitation from Ruby OKG and from an intensive Stokes component obtained with VKR in liquid nitrogen. (auth)

7049 (LA-tr—75-40) **Selective dissociation induced by absorption of strong infrared radiation in weak combination bands of polyatomic molecules.** Ambartsumian, R.V.; Gorokhov, Yu.A.; Letokhov, V.S.; Makarov, G.N.; Puretskii, A.A. Translated by A.D. Cernicek from *Zh. Eksp. Teor. Fiz., Pis'ma Red.*; No. 22, 374-377(1975). 12p. Dep. NTIS $4.50.

Dissociation and isotope separation of the SF_6 and CCl_4 molecules by the action of strong infrared radiation on a variety of combination bands is investigated. The rate of dissociation is shown to be proportional to the dipole moment of the excited vibration. (auth)

7050 **Hydrogen isotope separation from water.** Jensen, R.J. (to U.S. Energy Research and Development Administration). US Patent 3,904,500. 9 Sep 1975. Filed date 17 Dec 1973. 6p. PAT-APPL-423,367.

A process for separating tritium from tritium-containing water or deuterium enrichment from water is described. The process involves selective, laser-induced two-photon excitation and photodissociation of those water molecules containing deuterium or tritium followed by immediate reaction of the photodissociation products with a scavenger gas which does not substantially absorb the laser light. The reaction products are then separated from the undissociated water. (auth)

7051 (UCRL-Trans—10962) **Procedure for isotopic separation.** Petschek, H. Nov 1975. Translation of Belgian Patent 807,117. 19p. Dep. NTIS $4.50.

A procedure and apparatus are described for isotopic separation. The method, which is based on the selective ionization of an isotope by a laser beam in a medium that contains several isotopes, is applied to the separation of ^{235}U and ^{238}U. (JGB)

ORGANIC CHEMISTRY

CHEMICAL AND PHYSICOCHEMICAL PROPERTIES

7052 (BNL—20696) **Linear position sensitive counter system for protein crystallography.** Cain, J.E.; Norvell, J.C.; Alberi, J.; Schoenborn, B.P. (Brookhaven National Lab., Upton, N.Y. (USA)). 1975. 15p. (CONF-750629—6). Dep. NTIS $3.50.

From Symposium on neutron scattering for the analysis of biological structures; Upton, New York, USA (2 Jun 1975).

A position—sensitive counter system for collecting neutron diffraction data from protein crystals is described. A linear position-sensitive detector is utilized to permit faster data collection and allow the use of smaller crystals. Data are collected in a normal beam geometry with crystal rotation. Preliminary results obtained on a Cd derivative of myoglobin are reported. (JSR)

7053 (JUL-Conf—13, pp 199-216) **Spontaneous and induced generation of optical activity in racemic 1,1'-binaphthyl.** Pincock, R.E.; Bradshaw, R.P.; Perkins, R.R. (Univ. of British Columbia, Vancouver). Nov 1974.

From International symposium on generation and amplification of asymmetry in chemical systems; Julich, F.R. Germany (24 Sep 1973).

In International symposium on generation and amplification of asymmetry in chemical systems.

Spontaneous resolution of racemic compounds, spontaneous production of optically active 1,1'-binaphthyl, and induced resolution of 1,1'-binaphthyl are considered. (LK)

7054 (JUL-Conf—13, pp 217-231) **Can circularly polarized light be used to obtain chiral compounds of high optical purity.** Kagan, H.B.; Balavoine, G.; Moradpour, A. (Univ., Paris, Orsay, France). Nov 1974.

From International symposium on generation and amplification of asymmetry in chemical systems; Julich, F.R. Germany (24 Sep 1973).

In International symposium on generation and amplification of asymmetry in chemical systems.

The production of optically active compounds starting from optically inactive material and with the help only of circularly polarized light is briefly discussed. This problem is possibly related to the appearance of optical activity on earth. Some aspects of photochemical asymmetric synthesis of helicenes are given, the optical yields being always lower than 1 percent. The possibility of obtaining much higher optical purity by using partial asymmetric photodecomposition of a racemic mixture is then discussed. The kinetic treatment allows the prediction that at the end of the destruction the recovered material must be of high optical purity. An experimental demonstration of the correctness of the calculations is shown in the case of dl camphor. Camphor of 20 percent optical purity could be isolated after prolonged photolysis by circularly polarized light. (auth)

7055 (JUL-Conf—13, pp 233-238) **Proposal for mirror symmetry test in molecule.** Yamagata, Y. (Kanazawa Univ., Japan). Nov 1974.

From International symposium on generation and amplification of asymmetry in chemical systems; Julich, F.R. Germany (24 Sep 1973).

In International symposium on generation and amplification of asymmetry in chemical systems.

An experimental method to examine a molecular asymmetry induced by the parity non-conserved weak interaction is proposed. The method is to test a possible difference between numbers of d- and l-molecule of optical isomer by condensing the asymmetry and by accumulating the ORD signal with a signal averaging computer. The sensitivity is of an order of approximately 10^{-13} for a relative ratio of the difference to the total number. (auth)

7056 (JUL-Conf—13, pp 239-257) **Amplification processes for small primary differences in the properties of enantiomers.** Wagener, K. (Nuclear Research Center, Juelich, Ger.). Nov 1974.

From International symposium on generation and amplification of asymmetry in chemical systems; Julich, F.R. Germany (24 Sep 1973).

In International symposium on generation and amplification of asymmetry in chemical systems.

Differences in the free energy of enantiomers may have two principal reasons: (1) the result of a special arrangement of external fields, or (2) asymmetric interaction due to parity non-conservation. The effects, in general, will be very small so that an amplification is necessary in order to make them measurable. In doing so, the main problem is not to find a process of high amplification potential, but a reliable one where the obtained enantiomeric resolution is really due to differences in their properties and not an artifact caused by uncontrolled experimental parameters. Well-known cascading processes have been examined under this aspect, and two new types of amplifying processes involving solid phases and especially designed for this purpose, are described. (auth)

7057 (JUL-Conf—13, pp 259-271) **Amplification of asymmetry and enrichment in enantiomers through a polymeric system.** Spach, G. (CNRS, Orleans, France). Nov 1974.

From International symposium on generation and amplification of asymmetry in chemical systems; Julich, F.R. Germany (24 Sep 1973).

In International symposium on generation and amplification of asymmetry in chemical systems.

Amplification of asymmetry and enrichment in enantiomers can be achieved experimentally with a simple polymeric system, the polymerization of α-amino acid derivatives. These results suggest further experiments. Amplification of asymmetry is shown by helical synthetic copolypeptides built with L and D residues in the same chain. Thus, the asymmetry of the secondary structure of copolybenzyl D,L glutamates, expressed as the ratio right-handed helices/total helical conformation, is always higher than the disymmetry existing in the primary structure, expressed as the ratio L/(L + D). Besides, stereoselective polymerization of racemic amino acid derivatives, such as N-carboxyanhydrides or active esters, initiated by optically active polypeptides has been observed. Keeping these observations in mind, two possibilities of further amplification of asymmetry and enrichment in enantiomers were considered. First, to use the helical skeleton as an asymmetric matrix to promote the inversion of configuration of a residue incorporated in a "wrong" helix (for instance, inversion of a D-residue in a right-handed helical poly-D,L-peptide molecule). Second, to check the ability of one-screw sense helical poly-D,L-peptide molecules to initiate stereo-selectively the polymerization of enantiomers. (auth)

7058 (JUL-Conf—13, pp 273-288) **Disproportionation of enantiomers by precipitation.** Thiemann, W. (Kernforschungsanlage, Juelich, Ger.). Nov 1974.

From International symposium on generation and amplification of asymmetry in chemical systems; Julich, F.R. Germany (24 Sep 1973).

In International symposium on generation and amplification of asymmetry in chemical systems.

The paper presents some experiments which were aimed at the demonstration of enrichment of enantiomer substances by precipitation from saturated racemic solutions. As a working hypothesis we searched for a possible very small "asymmetry effect" that might be observable during precipitation if the solubilities of enantiomer components were affected. Crystallization of a small fraction out of a bulk of racemate would lead to an amplification of an elementary effect which by itself would have escaped any direct experimental verification. We chose DL-asparagine-monohydrate in aqueous solution as the system to be investigated. Of particular interest is the result that below 7.5°C the yield of D-asparagine seems to exceed that of L-asparagine in the precipitate, while above 8°C the opposite is true. This qualitative result is confirmed by extrapolation of experimental data gained from precipitation of non-racemic asparagine solutions—at least for a crystallization temperature of 0°C. (auth)

7059 (JUL-Conf—13, pp 383-400) **Possibility of spontaneous resolution of enantiomers on a catalyst surface.** Harrison, L.G. (Univ. of British Columbia, Vancouver). Nov 1974.

From International symposium on generation and amplification of asymmetry in chemical systems; Julich, F.R. Germany (24 Sep 1973).

In International symposium on generation and amplification of asymmetry in chemical systems.

A model reaction system is discussed, in which an asymmetric molecule is formed on a solid catalyst surface, the stereospecificity of which can be modified by adsorption of the asymmetricc product. Spontaneous resolution is shown to be possible if modification of one active site needs two adsorbed molecules. (auth)

7060 (JUL-Conf—13, pp 421-447) **Crystallization and solid-state reaction as a route to asymmetric synthesis from achiral starting materials.** Green, B.S.; Lahav, M. (Weizmann Inst. of Science, Rehovoth, Israel). Nov 1974.

From International symposium on generation and amplification of asymmetry in chemical systems; Julich, F.R. Germany (24 Sep 1973).

In International symposium on generation and amplification of asymmetry in chemical systems.

Molecules which are achiral can crystallize in chiral (enantiomorphic) crystals and under suitable conditions, crystals of only one chirality may be obtained. The formation of right- or left-handed crystals in excess is equally probable. Lattice-controlled (topochemical) photochemical or thermal solid-state reactions may then afford stable, optically active products. In the presence of the chiral products, achiral reactants may preferentially produce crystals of one chirality, leading to a feedback mechanism for the generation and amplification of optical activity. The optical synthesis of biologically relevant compounds by such routes may also be envisaged. (auth)

7061 (JUL-Conf—13, pp 501-512) **Review on the experimental work on generation of asymmetry in the laboratory of chemical biodynamics, Berkeley.** Lemmon, R.M. Nov 1974.

From International symposium on generation and amplification of asymmetry in chemical systems; Julich, F.R. Germany (24 Sep 1973).

In International symposium on generation and amplification of asymmetry in chemical systems.

Katchalsky method for producing polypeptides in dilute aqueous media, investigation of whether highly polarized muons show any difference in rates of reaction in a crystalline D- or L-amino acid, selective decomposition of D-tyrosine over L-tyrosine in dilute aqueous solution by β particles, and the report that L-aspartic acid polymerizes faster on kaolinite than does the D-acid are discussed. (LK)

7062 **Reactions of CHF_2^+ with n-donor bases by ion cyclotron resonance spectroscopy. The proton affinity of difluorocarbene.** Vogt, J.; Beauchamp, J.L. (California Inst. of Tech., Pasadena). *J. Am. Chem. Soc.*; **97**: No. 23, 6682-6685(12 Nov 1975).

The gas-phase ion--molecule reactions of CHF_2^+ with n-donor bases were investigated using the techniques of ion cyclotron resonance spectroscopy. CHF_2^+ reacts only by proton transfer with CH_3CN, CH_3CHO, CH_3OH, AsH_3, and CH_2O. While CHF_2^+ with excess translational and internal energy undergoes proton transfer to HCN, ground state CHF_2^+ does not react. CHF_2^+ is also unreactive with H_2O. Rate constants for ion-molecule reactions in the pure systems and for the proton transfer reactions are reported. The proton affinity of difluorocarbene is determined to be 172 +- 2 kcal/mole which is 7 kcal/mole lower than calculated from previously reported thermodynamic data. The possible use of CHF_2^+ as a reagent ion for chemical ionization is discussed, and some reservations are noted. (auth)

7063 (LBL—4530) **Polar hydrogen scattering factors in x-ray diffraction analysis.** Olson, A.J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1975. Contract W-7405-ENG-48. 190p. Dep. NTIS $8.50.

Thesis.

The feasibility of applying a polar model of bonded hydrogen electron density to x-ray diffraction analysis has been demonstrated. The modifications needed to accommodate the associated complex scattering factors in the least squares calculation have been described and have been shown to be readily incorporated into the standard crystallographic structure refinement program. Polar hydrogen scattering factors developed from the H_2 molecule by Stewart, Davidson, and Simpson have been applied to x-ray data from decaborane ($B_{10}H_{14}$) and sucrose ($C_{12}H_{22}O_{22}$). This application has yielded improvements over the spherical hydrogen model in the derived B-H, C-H, and O-H bond lengths as judged by comparison to the corresponding distances determined by neutron diffraction studies of the same molecules. The improvements have not been uniform among the different bonding types. Using this polar hydrogen model in x-ray refinements, mean deviations from the neutron bond lengths for B-H, C-H, and O-H are 0.019A, 0.043A, and 0.079A respectively. (LK)

7064 (LBL—4609) **Study of the simultaneous preparation of oligopeptides and oligonucleotides under prebiotic conditions.** Caroon, J.M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Aug 1975. Contract W-7405-ENG-48. 47p. Dep. NTIS $4.50.

Thesis.

The effect of imidazole in promoting the formation of biopolymers under chemical evolutionary conditions was investigated. At the onset of this work, it was known that short-chain oligonucleotides formed in aqueous solutions of ATP, imidazole, and $MgCl_2$; in addition, short peptides had been shown to form in aqueous solutions of aminoacylimidazolides and $MgCl_2$. The products formed in an aqueous solution of ATP, imidazole, alanine, and $MgCl_2$ was investigated and it was found that, under plausible prebiotic conditions, the formation of representatives of both peptides and oligonucleotides could be demonstrated. Furthermore, it was shown that the simultaneous formation of peptides increased the formation of oligonucleotides. A preliminary study was made on the possibility of inducing asymmetry in the clay catalyzed polymerization of peptides, but the results were discouraging. (auth)

7065 (UCLA—12-1040) **Origins of Circular Dichroism bands in Bowman—Birk soybean trypsin inhibitor.** Kay, E. (California Univ., Los Angeles (USA). Lab. of Nuclear Medicine and Radiation Biology). 1975. Contract E(04-1)-GEN-12. 35p. Dep. NTIS $5.00.

The spectral properties of Bowman-Birk soybean trypsin inhibitor (BBI) were investigated by analyzing difference absorption spectra and difference circular dichroism (CD) spectra and by comparing them with those of tyrosyl model compounds. The O-acetylation of tyrosyl side chains showed that the ultraviolet CD bands of BBI above 225 nm originate from disulfide side chains

and tyrosyl phenolic groups. A broad negative CD band centered around 280 nm in BBI arises mainly from disulfide bonds (ϵ/sub L/ - ϵ/sub R/ = -0.83 $M^{-1}cm^{-1}$ per disulfide). Each of two tyrosyl residues gives rise to negative CD at this region; together they contribute approximately 10 percent of the total CD intensity at 277 nm (ϵ/sub L/ - ϵ/sub R/ = -0.36 $M^{-1}cm^{-1}$ per tyrosyl). Disulfide bonds in BBI also have a broad positive CD band centered around 240 nm (ϵ/sub L/ - ϵ/sub R/ = 0.9 $M^{-1}cm^{-1}$ per disulfide). Tyrosyl side chains give rise to a sharp positive peak at 231 nm, overlapping with the positive disulfide CD. Dimerization of monomeric BBI did not alter the CD profile. Fully acetylated BBI has the near ultraviolet disulfide CD and the far ultraviolet polypeptide CD very similar to those of the native inhibitor, indicating that O-acetylation of two tyrosyl side chains did not induce much conformational change in BBI. The near ultraviolet CD of BBI was altered in the presence of 8 M urea or 6 M guanidine hydrochloride, with a greater change brought about by the latter. Dithiothreitol (20 mM) completely abolished the tyrosyl and disulfide CD in this region. (auth)

7066 (RFP-Trans—168) **Rate of decomposition of ammonium carbamate.** Baranski, A. Translated from *Chem. Stosow.*; **2**: 231-236(1963). 12p. Dep. NTIS $4.50.

The decomposition velocities of crystals (various size I, II, III) of ammonium carbamate have been measured over the temperature range of 14 to 26°C. The products of dissociation were removed by a stream of air. Relationship between the loss of weight (x) and time (t) for the first order reaction $NH_4CO_2NH_2$ yields $2NH_3 + CO_2$ is represented in tables and figures. The velocity decomposition constants and activation energy (11 Kcal/mol) were evaluated. Decomposition velocities of various compounds of the NH_3—CO_2—H_2O system are shown graphically. (auth)

7067 (ORNL-tr—4037) **Microbiological degradation of phenol compounds.** Zdybiewska, M. Translated from *Postepy Mikrobiol.*; **7**: 161-179(1968). 22p. Dep. NTIS $4.50.

Reasons for the occurrence of phenols, especially in water and sewage, are discussed. These compounds distinctly affect the biocoenosis of the receiver both in respect to higher organisms, as e.g., fish, as well as to microorganisms. Thanks to adaptation some microorganisms become able to decompose phenols. Usually the biological oxidization of various cyclic compounds is achieved by forming pyrocatechol, which is then oxidized to simple organic acids. These processes are due to bacteria, actinomycetes, moulds and yeast. They are influenced by such parameters as: pH, temperature, nutritive substances as well as substances associated in the phenols. The suitable choice of these parameters ensures proper effects in processes of biological treatment. 90 references. (auth)

7068 **Direct fluorination of polycyclic hydrocarbons with xenon difluoride.** Anand, S.P. (Illinois Inst. of Tech., Chicago); Quarterman, L.A.; Christian, P.A.; Hyman, H.H.; Filler, R. *J. Org. Chem.*; **40**: No. 25, 3796-3797(12 Dec 1975).

ISOTOPE EFFECTS

7069 **Spin lattice relaxation in an AM[X/sub n/] system: application to ^{13}C relaxation in enriched molecules.** London, R.E.; Matwiyoff, N.A.; Mueller, D.D. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87544). *J. Chem. Phys.*; **63**: No. 10, 4442-4449(15 Nov 1975).

In ^{13}C-enriched molecules, ^{13}C—^{13}C dipolar interactions can contribute significantly to the relaxation of ^{13}C nuclei which are not directly bonded to protons. Comparison of the relaxation behavior of the ^{13}C—^{13}C multiplet lines with that of the singlet for which there are no ^{13}C—^{13}C dipolar interactions allows a quantitative analysis of this interaction. However, since ^{13}C—^{13}C dipolar interactions are necessarily weak, substantial contributions to the relaxation of nonprotonated carbon atoms are made by protons attached to adjacent atoms. The general features of the spin lattice relaxation behavior of an AM{X} system in which {X} represents the decoupled protons, A, the nonprotonated carbon, and M, the adjacent protonated carbon, have been derived. In general, the A relaxation will be nonexponential and dependent on the initial state of the M/sub z/ magnetization. A particularly useful application of these measurements on ^{13}C-enriched systems is found in their sensitivity to internal and/or anisotropic motions. Such rotations affect the ^{13}C—^{13}C and ^{13}C-^{1}H dipolar interactions differently, depending on the particular geometry involved and the axis of rotation. These techniques have been applied to the observed relaxation behavior of 6-phosphogluconate enriched to the 79% level. In this case the contributions to the intramolecular dipolar relaxation ofthe carboxyl carbon consist primarily of the ^{13}C—^{13}C interaction with its adjacent carbon, the ^{13}C-^{1}H interaction with the proton on the adjacent carbon, and a significant contribution from the proton attached to the third carbon in the chain. For this case, it is found that the carboxyl relaxation will be, to a very good approximation, exponential and independent of the initial value of M/sub z/. Furthermore, a significantly improved fit of the data results if anisotropic rotation effects are considered. (AIP)

ELECTROCHEMISTRY

7070 (SAND—75-5942) **Soft modes and related properties in cubic PbF_2.** Samara, G.A. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1975. 8p. (CONF-751218—1). Dep. NTIS $4.50.

From International conference on low lying lattice vibrational modes and their relationship to super-conductivity and ferroelectricity; San Juan, Puerto Rico, USA (1 Dec 1975).

Studies of the temperature and pressure dependences of the static dielectric constant and ionic conductivity of cubic PbF_2 have led to the discovery of two important results: (i) the existence of a soft q = 0, TO phonon mode and (ii) an anomalously large initial decrease with pressure in the activation energy for ionic conduction. The TO mode softens only partially with decreasing T, the crystal remaining stable down to the lowest temperatures. Cubic PbF_2 is, however, known to undergo a pressure-induced transition to an orthorhombic phase. The possibility of a connection between the ionic conductivity and soft modes in PbF_2 is discussed. (auth)

7071 (UCRL-Trans—10969) **Inner friction of electrolytic solutions and their interpretation according to the Debye theory .** Falkenhagen, H.; Dole, M. Translated from *Phys. Z.*; **30**: 611-622(1 Oct 1929). 24p. Dep. NTIS $4.50.

Equations describing the inner friction of electrolytic solutions are derived for the case of binary electrolytes with ions of the same mobility. It is shown that the dependence of the relative inner friction of the square root of the concentration is a result of the interionic Coulomb forces. The general basic equations are first developed. (JSR)

7072 (ORNL-tr—2956) **Cell Pt, H_2(1 atm)/HCl, Hg_2Cl_2(s)/Hg in organic solutions and their mixtures with water.** Schwabe, K.; Mueller, R. Translated by M. Gerrard from *Ber. Bunsenges. Phys. Chem.*; **73**: No. 2, 178-184(1969). 22p. Dep. NTIS $4.50.

Up to a propanol content of 60 percent, the same values were found for the mean activity coefficients f'/sub +-/ and f'/sub perpendicular to/ and the ptH' and ptH* values, using hydrogen and glass electrodes in cells without transference. The less satisfactory agreement at higher propanol contents is attributed to a change of the swelling layer by take-up of propanol. With respect to the mass fraction of water, the primary medium effect obeys the equation of Feakins and French up to about 80 percent; up to 80 percent propanol it agrees perfectly with that for isopropanol. Comparison of the different straight-chain alcohols shows the hydration number calculated according to Feakins and French to increase linearly with the number of C atoms, while for isopropanol it is distinctly higher than for n-propanol. (auth)

PHOTOCHEMISTRY

7073 (JUL-Conf—13, pp 109-130) **Celestial asymmetry as a possible cause of small chemical asymmetry and autocatalytic amplification of the latter.** Moertberg, L. (Univ., Umea, Sweden). Nov 1974.

From International symposium on generation and amplification of asymmetry in chemical systems; Julich, F.R. Germany (24 Sep 1973).

In International symposium on generation and amplification of asymmetry in chemical systems.

Some explanations of net chemical asymmetry invoke external physical asymmetric influences such as circularly polarized light acting photochemically. These are discussed. (LK)

RADIATION CHEMISTRY

7074 (LBL—4000, pp 350-351) **Heavy ion irradiation of solid glycine.** Tung, T.L.; Sokol, H.A.; Bennett-Corniea, W.; Welch, G.P.; Garrison, W.M. Jul 1975.

In Nuclear chemistry. Annual report, 1974.

7075 (ORO—4213-2) **Research and engineering studies of the radiation-induced gas phase grafting of butadiene to polyvinyl chloride. Final report.** Smith, T.G.; Silverman, J.; Maaghoul, M.; Block, I.; Higaki, H.; Hamanoue, K.; Shimizu, M. (Maryland Univ.,

College Park (USA). Dept. of Chemical Engineering). 1973. Contract AT(40o1)-4213. 186p. Dep. NTIS $7.50.

The radiation-induced heterogeneous graft polymerization of butadiene vapor to polyvinyl chloride powder was investigated in a pilot-scale continuous recirculating reactor system. A ^{60}Co source provided the γ radiation field. The effects of processing variables on the kinetics of the graft polymerization, including post-grafting reactions outside the radiation field, were determined. Several mathematical models were developed to simulate the performance of the experimental system and to obtain the conversion histories at different locations in the reactor system. An unsteady state model was shown to represent adequately the experimental conversion histories. (JSR)

7076 Treatment of sewage sludge with combinations of heat and ionizing radiation (thermoradiation). Sivinski, H.D. (Sandia Labs., Albuquerque, NM). pp 151-167 of In Radiation for a clean environment. Vienna; International Atomic Energy Agency (1975).

From Symposium on the use of high level radiation in waste treatment status and prospects; Munich, F.R. Germany (17 Mar 1975).

See STI/PUB—402; CONF-750316—.

Research on the application of a combined heat and ionizing radiation treatment to sewage sludge is described. This treatment can be optimized to maximize synergistic biological inactivation of pathogens such as bacteria, viruses and parasites. The enhancement of desirable chemical and physical effects resulting from this treatment is also being studied. (auth)

7077 Electron reactions and electron transfer reactions catalyzed by micellar systems. Graetzel, M.; Kozak, J.J.; Thomas, J.K. (Univ. of Notre Dame, IN). *J. Chem. Phys.*; **62**: No. 5, 1632-1640(1 Mar 1975).

The kinetics of the reaction of hydrated electrons with pyrene, pyrene butyric acid, and pyrene sulfonic acid (PSA) have been investigated in aqueous solutions of cetyltrimethylammonium bromide (CTAB). With all three solubilizates the formation of the electron adduct (P^-) occurs very rapidly with rate constants greater than 10^{11} $M^{-1}.sec^{-1}$. These abnormally high rate constants are shown to be due to fast trapping of e^-/sub aq/ in the positive potential field of the middle and subsequent efficient penetration of electrons into the micellar interior. A similar enhancement was observed for electron transfer reactions between CO_2^- and solutes solubilized in or on the micelle. For example CO_2^- readily transfers an electron to pyrene sulfonic acid on the surface of the micelle. This reaction does not occur in homogeneous solution but is catalyzed by the positive electrostatic surface potential. Addition of electrolyte drastically reduces the rate of e^-/sub aq/ and CO_2^- with solubilizates. The Debye-Hueckel theory of electrolytes was invoked to elucidate the role of the charged micellar interface in facilitating the penetration of the electron into the micelle and promoting the electron transfer reaction on the surface. Ion distributions were calculated via solution of a Poisson—Boltzmann equation, generalized to take into account the probable change of the microscopic dielectric constant in the vicinity of the micellar interface. (auth)

7078 Water vapor dependence of the kinetics of the self-reaction of HO_2 in the gas phase. Hamilton, E.J. Jr. (Argonne National Lab., IL). *J. Chem. Phys.*; **63**: No. 8, 3682-3683(15 Oct 1975).

Pulse radiolysis experiments which show the previously unrecognized dependence of k_1 measurements on the amount of water vapor present are reported. (auth)

7079 Electron—electron double resonance study of coherent and random rotational motion of methyl groups. Mottley, C.; Kispert, L.D.; Clough, S. (Chemistry Department, The University of Alabama, Tuscaloosa, Alabama 35486). *J. Chem. Phys.*; **63**: No. 10, 4405-4411(15 Nov 1975).

Electron—electron double resonance (ELDOR) spectra are reported for the free radical $CH_3C(COOH)_2$ in x-irradiated crystals of methylmalonic acid over the temperature range 10 to 50 K. At low temperatures tunneling sidebands are observed corresponding to simultaneous flips of the electron spin and changes in the tunneling rotation state of the methyl group. The previous assignment of weak satellite lines of the electron spin resonance (ESR) spectrum to these transitions is unequivocally confirmed, and sidebands obscured in the ESR spectrum are clearly observed in the ELDOR spectrum with the expected frequencies and intensities. The temperature dependence of the frequencies confirms the previous observation of the temperature dependence of the frequency of tunneling rotation of the methyl group. A sequence of changes with rising temperature in the relative amplitudes of lines in the ELDOR spectra is accounted for in a qualitative way as a consequence of the changing rates of several cross relaxation processes, all of which arise as a consequence of the modulation of the electron—proton hyperfine interaction by thermally activated rotation of the methyl group about its symmetry axis. (AIP)

7080 Electron spin resonance studies of γ-irradiated phosphite and phosphate esters. Identification of phosphinyl, phosphonyl, phosphoranyl, and phosphine dimer cation radicals. Kerr, C.M.L.; Webster, K.; Williams, F. (Univ. of Tennessee, Knoxville). *J. Phys. Chem.*; **79**: No. 24, 2650-2662(20 Nov 1975).

The powder ESR spectra of several γ-irradiated phosphorus esters at 77°K were analyzed into their distinguishable radical components, each spectrum being generally a composite of anisotropic features from a number of alkyl and phosphorus-centered radicals. Resolution of overlapping spectra was achieved in some instances by radiation-chemical experiments designed to suppress or enhance the products of electron capture relative to the radicals formed by other mechanisms. The radiation chemistry of dialkyl phosphites, $(RO)_2P(O)H$, is influenced by the ease with which the P—H bond in these compounds is broken, the principal radicals being the phosphonyl species $(RO)_2PO$ and $ROP(O)O^-$. Both of these species are thought to be the secondary products of hydrogen atom abstraction by the alkyl radical R which is produced by dissociative electron capture. A similar primary step was found to apply for the trialkyl phosphates, $(RO)_3PO$, but in this case only carbon-centered radicals are formed by secondary H-atom abstraction processes. Results for the pyrophosphite differ from those for the trialkyl phosphites in showing the absence of alkyl radicals or their phosphoranyl adducts and the formation of the phosphonyl species $(EtO)_2PO$, the latter being produced presumably by cleavage of the P—O—P bridge. The ESR parameters for each of the four main groups of phosphorus-centered radicals are summarized and the electronic structures of these radicals are discussed briefly. (auth)

7081 Electron spin resonance studies of γ-irradiated phosphorus compounds containing phosphorus—chlorine bonds. Kerr, C.M.L.; Webster, K.; Williams, F. (Univ. of Tennessee, Knoxville). *J. Phys. Chem.*; **79**: No. 24, 2663-2668(20 Nov 1975).

ESR experiments similar to those described in the preceding paper were used to identify the radicals produced in a series of γ-irradiated phosphorus compounds containing phosphorus—chlorine bonds. The principal species formed from diethyl chlorophosphite are the neutral radicals $P(OEt)_2$ and $(EtO)_2PCl_2$ presumably by loss and addition of chlorine atoms, although there is evidence that the former species is produced at least in part by dissociative electron capture. On the other hand, the major radical derived from a series of chlorophosphate esters is invariably the chlorophosphoranyl radical anion formed by simple electron attachment to the parent molecule. In the dichlorophosphoranyl radicals, there is a large ^{35}Cl coupling from the two equivalent chlorines in the apical positions of a trigonal bipyramidal structure. Evidence for the anisotropy of this coupling suggests that a significant spin density resides in the 3p/sub sigma/ orbitals of these chlorine ligands, in agreement with recent single crystal studies on $POCl_3^-$. The much greater stability of radical anions derived from chlorophosphates relative to those from di- and trialkyl phosphate esters, which undergo efficient dissociation, is interpreted in terms of the effect of ligand electronegativity on the spin density distribution. This effect is consistent with recent MO descriptions which indicate that the half-occupied orbital in phosphoranyl radicals is largely localized along the axial three-center bond. (auth)

7082 Electron spin resonance and pulse radiolysis studies of some reactions of SO_4^-. Chawla, O.P.; Fassenden, W. (Carnegie-Mellon Univ., Pittsburgh). *J. Phys. Chem.*; **79**: No. 24, 2693-2700(20 Nov 1975).

The in-situ photolysis of aqueous solutions of peroxydisulfate ($S_2O_8^{2-}$) was investigated as a source of radicals for ESR studies. This initiating system was found to be quite effective in that the SO_4^- so produced reacts readily with a variety of solutes; successful detection of a number of new radicals was possible. Attention was focused mainly on radicals resulting from reaction of SO_4^- with inorganic ions. Direct observations were made where possible, and spin trapping with CH_2 double bond NO_2^- or fumarate was used in other cases. Radicals directly observed include CO_2^- from formate, CO_3^- from bicarbonate, HO_2 from H_2O_2, and H_2NO from NH_2OH. The g factor of CO_2^- was found to be 2.00045 and the line width 2.3 G. No change in parameters was found over the pH range 0.8 to 4.6. The radical CO_3^- with g = 2.0113 and line width 4.4 G is reported for the first time in aqueous solution. No changes in the spectrum which might give evidence for the pK of this radical were found over the pH range 7.5 to 11.9. The pK for the dissociation PO_3H^- reversible $H^+ + PO_3^{2-}$ was determined to be 5.9. Evidence for reaction of SO_4^- with NH_3, CN^-, $H_2PO_4^-$, and Cl^- was obtained by trapping the resultant radicals which are believed to be NH_2, CN, PO_4^{2-}, and Cl_2^-, respectively. Pulse radiolysis studies confirm the formation of Cl_2^- from Cl^- (k/sub $SO_4^- + Cl^-$/ = 3.1 x 10^8 M^{-1} sec^{-1}) by means

of its absorption spectrum. Thus the reaction SO_4^- + Cl^- can be used to provide a source of Cl_2^- in neutral and basic solutions. Conductometric pulse radiolysis studies were carried out on several organic unsaturated compounds to clarify the nature of the SO_4^- reaction. It was concluded that SO_4^- adds to the simple olefins cyclohexene and allyl alcohol while a direct oxidation of benzene to hydroxycyclohexadienyl radical occurs in the time scale of less than 10 μsec. (auth)

RADIOCHEMISTRY AND NUCLEAR CHEMISTRY

PROPERTIES OF RADIOACTIVE MATERIALS

7083 (CONF-750827—, pp 223-232) **Summary review of Mound Laboratory's experience in D and D of radioactive facilities, 1949—1973.** Garner, J.M.; Davis, W.P. (Mound Lab., Miamisburg, OH). Sep 1975.

From Conference on decontamination and decommissioning of ERDA facilities; Idaho Falls, Idaho, USA (19 Aug 1975).

In Proceedings of the first conference on decontamination and decommissioning (D and D) of ERDA facilities.

The objective of Mound Laboratory's Decontamination and Decommissioning (D and D) projects has been the effective termination of radioactive material processing facilities with no significant personnel exposures or environmental releases. This objective must be met with available resources and manpower. Mound has effectively decontaminated and/or decommissioned four major facilities in the 1949 through 1973 time period. Many minor areas were also decontaminated and/or decommissioned during this period. The major D and D projects involved the following isotopes: polonium-210, radium-226, actinium-227, and plutonium-238. To achieve a D and D status, Mound has employed several control and decontamination techniques such as: "Navy Cocooning", entombment, removal, foaming, bagging, tents, chutes, portable exhausters, dry ice, vents, bubble suits, three-zones, fire watches, painting and sealing, in-line cleaning, high pressure water blaster, and chemical cleaning. (auth)

7084 (CONF-750827—, pp 233-252) **Decommissioning of the Fission Product Development Laboratory at Holifield National Laboratory.** Schaich, R.W. (Holifield National Lab., Oak Ridge, TN). Sep 1975.

From Conference on decontamination and decommissioning of ERDA facilities; Idaho Falls, Idaho, USA (19 Aug 1975).

In Proceedings of the first conference on decontamination and decommissioning (D and D) of ERDA facilities.

The decontamination of the Fission Product Development Laboratory was initiated in FY 1975 after 17 years of processing fission product waste streams to produce commercial quantities of ^{90}Sr, ^{137}Cs, ^{144}Ce, and ^{147}Pm. The objective of the decommissioning program is the removal of all radiation and contamination areas in the facility to a level which will be compatible with the environment in the foreseeable future. (auth)

7085 (CONF-750827—, pp 295-302) **Dismantling an alpha-contaminated facility.** Caldwell, R.D.; Harper, R.M. (E.I. du Pont Co., Aiken, SC). Sep 1975.

From Conference on decontamination and decommissioning of ERDA facilities; Idaho Falls, Idaho, USA (19 Aug 1975).

In Proceedings of the first conference on decontamination and decommissioning (D and D) of ERDA facilities.

The difficult task of removing large pieces of highly contaminated equipment from an obsolete plutonium-239 facility was completed in a seven-month operation that included structural alteration of the process building. Detailed job planning, job execution and contamination control were major factors in accomplishing the task. (auth)

7086 (DP-MS—75-57) **Introduction to tritium technology.** Meyer, L.H. (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Lab.). 1975. Contract AT(07-2)-1. 14p. (CONF-751115—5). Dep. NTIS $4.50.

From 23. conference on remote systems technology; San Francisco, California, USA (16 Nov 1975).

Some ways of making tritium technology information (now classified) available to the current fusion program workers are discussed. (LK)

7087 (LBL—4000, pp 331) **Crystal and molecular structures of thorium and uranium tetrakis (hexafluoroacetonylpyrazolide) complexes.** Volz, K.; Zalkin, A.; Templeton, D.H. Jul 1975.

In Nuclear chemistry. Annual report, 1974.

7088 (LBL—4000, pp 336-338) **Radiopolarographic studies of Cf, Es, and Fm.** David, F. (Institut de Physique Nucleaire, Orsay, France); Samhoun, K. Jul 1975.

In Nuclear chemistry. Annual report, 1974.

7089 (LBL—4000, pp 338-339) **Some thermodynamic properties of 5f elements.** David, F. (Institut de Physique Nucleaire, Orsay, France); Samhoun, K.; Guillaumont, R.; Nugent, L.J. Jul 1975.

In Nuclear chemistry. Annual report, 1974.

7090 (LBL—4000, pp 340-342) **Magnetic susceptibility of ^{249}Cf metal.** Fujita, D.K. (Oak Ridge National Lab., TN); Parsons, T.C.; Peterson, J.R.; Noe, M.; Edelstein, N. Jul 1975.

In Nuclear chemistry. Annual report, 1974.

7091 (LBL—4000, pp 342-344) **EPR of Cf^{3+} in octahedral symmetry and the nuclear dipole moment of ^{249}Cf.** Edelstein, N. (E.I. duPont de Nemours and Co., Aiken, SC); Karraker, D.G. Jul 1975.

In Nuclear chemistry. Annual report, 1974.

7092 (LBL—4000, pp 344-346) **Reactions of dithiolate ligands with uranium (IV) halides.** Gradl, R.; Edelstein, N. Jul 1975.

In Nuclear chemistry. Annual report, 1974.

7093 (LBL—4000, pp 346-347) **Some reactions of neptunium hexafluoride and the synthesis of $NpOF_4$.** Peacock, R.D. (The Univ., Leicester, England); Edelstein, N. Jul 1975.

In Nuclear chemistry. Annual report, 1974.

7094 (ORO—4447-031) **Physical—chemical studies of transuranium elements. Progress report, April 1, 1975—March 31, 1976.** Peterson, J.R. (Tennessee Univ., Knoxville (USA). Dept. of Chemistry). 1975. Contract AT(40-1)-4447. 28p. Dep. NTIS $4.00.

Major advances in our continuing program to determine, interpret, and correlate the basic chemical and physical properties of the transuranium elements are summarized for the period April 1, 1975, to March 31, 1976. Several instrumentation improvements were made which significantly improve the performance and data handling capabilities of our microscope-spectrophotometer. Spectroscopic and complementary x-ray powder diffraction studies were carried out on $EsBr_3$, $EsCl_3$, EsOBr, an Es(III) bromide, an Es(III) iodide, CfI_3, and CfI_2. As yet $EsBr_3$ has not been shown to undergo thermal reduction in a manner analogous to $CfBr_3$. Single crystals of $K_4NpO_2(CO_3)_3$, $BaNpO_2(C_2H_3O_2)_3$. $2H_2O$, $Na_4NpO_2(O_2)_3$. $9H_2O$, and $Na_4UO_2(O_2)_3$.$9H_2O$ were grown and analyzed by x-ray diffraction and absorption spectroscopy. Precise bond distances were determined, and the spectral behavior of the neptunyl ion was observed as a function of crystal orientation and ligand field. The performance of our solution microcalorimeter was improved by rebuilding the wheatstone bridge, installing a high-quality ground, and developing further a sample containment bulb which will minimize the possibility of incomplete dissolution of the sample. A micropolarographic cell was developed, evaluated, and used in several attempts to determine the Es(III)—Es(II) potential in acetonitrile. Experimental difficulties were encountered in the handling and dissolution of the einsteinium. (auth)

7095 **Single-crystal growth of MF_2:UF_4:CeF_3 (M=Ca, Sr, Ba) solid solutions.** Catalano, E.; Wrenn, E.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). *J. Cryst. Growth;* **30**: No. 1, 54-60(Aug 1975).

The melt growth of solid-solution single crystals of MF_2:UF_4:CeF_3(M = Ca, Sr, Ba) is described. Comments on relevant parts of binary MF_2—UF_4 systems applicable to the crystal-growth problem and some new information are also presented. The question of a crystallographic phase transformation in pure UF_4 was investigated. (NL)

7096 **Detrapping of interstitial helium in metal tritides: NMR studies.** Weaver, H.T.; Camp, W.J. (Sandia Labs., Albuquerque, NM). *Phys. Rev., B;* **12**: No. 8, 3054-3059(15 Oct 1975).

Measurements of NMR line shapes and relaxation times were made for ^3H nuclei and their β-decay products ^3He in aged samples of titanium tritide (Ti ^{3}H/sub x/). Data were obtained on samples aged 1 y (x = 1.7) and 8 y (x = 1.4), where x is the initial concentration. These data indicate that ^3He atoms are trapped interstitially in young crystals; whereas, in contrast, the older samples are found to contain helium-gas bubbles. Additionally, the younger sample was found to exhibit considerably more lattice distortion than the older sample. This is the first direct evidence for a detrapping mechanism which has been supported by a grow-

ing body of indirect evidence. A theory is described which explains the detrapping by a percolative mechanism: When enough ^{3}He atoms have been created to exceed a relevant critical percolation density, the helium atoms, which are considerably "oversized" for available interstices, are able to cooperatively strain the lattice beyond its elastic limit, hence irreversibly-deforming the lattice. The subsequent rapid diffusion of helium would then allow heterogeneous bubble nucleation with release of helium from the crystal by blistering and/or release along grain boundaries. (auth)

ENGINEERING

7097 (CONF-750827—, pp 367-382) **Design features for decontamination in new plutonium facilities.** Freiberg, K.J.; Haynes, C.G. (Rockwell International, Golden, CO). Sep 1975.

From Conference on decontamination and decommissioning of ERDA facilities; Idaho Falls, Idaho, USA (19 Aug 1975).

In Proceedings of the first conference on decontamination and decommissioning (D and D) of ERDA facilities.

Specific features for preventing, containing, controlling, and removing contamination in the Plutonium Recovery and Waste Treatment Facility are outlined. (LK)

GENERAL ENGINEERING

7098 (LBL—3868) **Sliding response of rigid bodies to earthquake motions.** Aslam, M.; Godden, W.G.; Scalise, D.T. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1975. Contract W-7405-eng-48. vp. Dep. NTIS $7.60.

A fundamental study of the sliding response of massive concrete blocks to earthquake ground motions, including the effect of vertical accelerations/decelerations on the friction forces, is reported. This particular problem occurs when large concrete blocks are used as radiation shields in nuclear particle accelerator installations in seismic areas. The results of this study can also help in understanding the response of other rigid bodies (as approximated by some electrical/mechanical equipment) which are not anchored to the ground. Based upon the simple theory of friction and equations of motion, a computer program BLOKSLD was written to predict the sliding motion of a rigid block under the effect of simultaneous horizontal and vertical earthquake accelerations. The accuracy of computer-predicted results was checked against the experimental data and a satisfactory agreement (10 percent) was found. Tests were conducted with concrete blocks on a newly constructed 20 x 20 ft shaking table which can reproduce independent horizontal and vertical displacement components. Tests were made for both sinusoidal and actual earthquake ground motions. Various materials were tried between the concrete block and the shaking table to reduce the coefficient of friction and to study the suitability of such materials for this purpose. Input table accelerations and the relative displacements between table and block were recorded for comparison with computer results. (auth)

7099 (UCRL—50025-75-4, pp 8-10) **LLL sphere-winding machine.** 8 Oct 1975.

In Electronics Engineering Department quarterly report No. 4, 1975.

As part of a National Aeronautics and Space Administration (NASA) research contract to determine optimum winding patterns for high-efficiency (maximum strength/minimum weight), composite-material, spherical pressure vessels, a highly flexible, computer-controlled filament-winding machine was designed. This four-axis, fully programmable machine can precision wind polymeric material around spherical forms ranging from 3 to 15 in. in diameter. In addition, it allows winding patterns and parameters (e.g., pitch, position, bandwidth) to be changed quickly and easily, even during the winding operation. The desired change is simply teletyped into the unit's interactive, high-level-language control program. Initial pressure vessels were successfully tested to burst strengths equal to the best vessels wound on existing filament-winding machines. (auth)

7100 **Electrolytic dissolver.** Wheelwright, E.J.; Fox, R.D. (to Energy Research and Development Administration). US Patent 3,901,786. 26 Aug 1975. Filed date 10 Apr 1974. 10p.

This patent related to an electrolytic dissolver wherein dissolution occurs by solution contact including a vessel of electrically insulative material, a fixed first electrode, a movable second electrode, means for insulating the electrodes from the material to be dissolved while permitting a free flow of electrolyte therebetween, means for passing a direct current between the electrodes and means for circulating electrolyte through the dissolver. (auth)

FACILITIES AND EQUIPMENT

7101 (AECL—5234) **A finite element computer program for the calculation of the resonant frequencies of anisotropic materials.** Fleury, W.H.; Rosinger, H.E.; Ritchie, I.G. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). Sep 1975. 62p. Dep. NTIS (US Sales Only) $5.50. AECL $2.00.

A set of computer programs for the calculation of the flexural and torsional resonant frequencies of rectangular section bars of materials of orthotropic or high symmetry are described. The calculations are used in the experimental determination and verification of the elastic constants of anisotropic materials. The simple finite element technique employed separates the inertial and elastic properties of the beam element into station and field transfer matrices respectively. It includes the Timoshenko beam corrections for flexure and Lekhnitskii's theory for torsion-flexure coupling. The programs also calculate the vibration shapes and surface nodal contours or Chladni figures of the vibration modes. (auth)

7102 (CONF-750827—, pp 165-206) **Disposition of TA-33-21, a plutonium contaminated experimental facility.** Cox, E.J.; Garde, R.; Valentine, A.M. (Los Alamos Scientific Lab., NM). Sep 1975.

From Conference on decontamination and decommissioning of ERDA facilities; Idaho Falls, Idaho, USA (19 Aug 1975).

In Proceedings of the first conference on decontamination and decommissioning (D and D) of ERDA facilities.

This report discusses the decontamination, demolition and disposal of a plutonium contaminated experimental physics facility which housed physics experiments with plutonium from 1951 until 1960. The results of preliminary decontamination efforts in 1960 are reported along with health physics, waste management, and environmental aspects of final disposition work accomplished during 1974 and 1975. (auth)

7103 (CONF-750827—, pp 207-221) **Separations canyon decontamination facilities.** Hershey, J.H. (E.I. du Pont de Nemours and Co., Aiken, SC). Sep 1975.

From Conference on decontamination and decommissioning of ERDA facilities; Idaho Falls, Idaho, USA (19 Aug 1975).

In Proceedings of the first conference on decontamination and decommissioning (D and D) of ERDA facilities.

Highly radioactive process equipment is decontaminated at the Savannah River Plant in specially equipped areas of the separations canyon building so that direct mechanical repairs or alterations can be made. Using these facilities it is possible to decontaminate and repair equipment such as 10- x 11-ft storage tanks, 8- x 8-ft batch evaporator pots and columns, 40-in. Bird centrifuges, canyon pumps and agitators, and various canyon piping systems or "jumpers." For example, centrifuge or evaporator pots can be decontaminated and rebuilt for about 60 percent of the 1974 replacement cost. The combined facilities can decontaminate and repair 6 to 10 pieces of major equipment per year. Decontamination time varies with type of equipment and radioactivity levels encountered. (auth)

7104 (CONF-750827—, pp 303-324) **Demolition of Building 12, an old plutonium filter facility.** Christensen, E.L.; Garde, R.; Valentine, A.M. (Los Alamos Scientific Lab., NM). Sep 1975.

From Conference on decontamination and decommissioning of ERDA facilities; Idaho Falls, Idaho, USA (19 Aug 1975).

In Proceedings of the first conference on decontamination and decommissioning (D and D) of ERDA facilities.

This report discusses the decommissioning and disposal of a plutonium-contaminated air filter facility that provided ventilation for the main plutonium processing plant at Los Alamos from 1945 until 1973. The health physics, waste management, and environmental aspects of the demolition are also discussed. (auth)

7105 (CONF-750827—, pp 345-365) **PNL studies of D and D at Hanford.** Harmon, K.M. (Battelle Pacific Northwest Labs., Richland, WA). Sep 1975.

From Conference on decontamination and decommissioning of ERDA facilities; Idaho Falls, Idaho, USA (19 Aug 1975).

In Proceedings of the first conference on decontamination and decommissioning (D and D) of ERDA facilities.

In summary, the PNL D and D at-Hanford program involves (1) the preparation of a long-term plan for a systematic approach to the extensive and varied problems of decommissioning retired facilities at Hanford; and (2) a D and D demonstration project, the decommissioning of a grossly contaminated plutonium processing facility. (auth)

7106 (CONF-750827—, pp 403-416) **Hot Fuel Examination Facility/South refurbishment program.** Larsen, L.; Miles, C.C. (Argonne National Lab., IL). Sep 1975.

From Conference on decontamination and decommissioning of ERDA facilities; Idaho Falls, Idaho, USA (19 Aug 1975).

In Proceedings of the first conference on decontamination and decommissioning (D and D) of ERDA facilities.

The Hot Fuel Examination Facility/South has been in continuous service since 1964. With the exception of a two-month air cell shutdown in 1969, all maintenance and repair has been done either remotely or by the removal of components from the cells for repair or replacement. The point has now been reached where extensive overhaul is required, and a major shutdown of the facility is planned. During the facility shutdown, the in-cell equipment will be removed from the cells. The cells will be decontaminated, cell windows and lighting will be modified, and remote-handling equipment will be improved. When the cells and cell equipment have been cleaned and modified, the facility will be returned to service in support of the LMFBR program. (auth)

7107 (LA—6135-MS) **Rock property measurements pertinent to the construction of drainage systems at archaeological sites in Arizona by subterrene penetrators.** Pharr, G.M. (Los Alamos Scientific Lab., N.Mex. (USA)). Oct 1975. Contract W-7405-ENG-36. 12p. Dep. NTIS $4.00.

Subterrene penetrators have been proposed to construct drainage systems at several archaeological sites in the southwestern United States. Several properties of the rocks at these sites must be known to determine the feasibility of penetration by Subterrenes, and when feasible, to select the type of drainage system to be constructed as well as the type of penetrator to be used. These rock properties include melting characteristics, permeability, density, and porosity. Methods for obtaining values of these properties are outlined, and some data as measured are given for several samples from the archaeological sites. (auth)

7108 (PERC—0055-1) **Bubble behavior on the scale-up of fluidized bed heat exchangers. Quarterly technical progress letter, 1 September 1975—30 November 1975.** (Idaho Univ., Moscow (USA)). 1975. Contract E(36-3)-0055. 4p. Dep. NTIS $3.50.

Progress during Sept. to Dec. 1975 in research on fluidized bed heat exchangers is reported. Heat transfer measurements were completed for a vertical tube immersed in 230 μ spherical glass beads with results similar to those obtained in the thin beds. Results using heat transfer models for thin beds with 230 μ and 470 μ glass spheres are compared with experimental data. Only the single particle conduction model of Botterrill gives consistent results for both size particles. (LCL)

7109 (SAND—74-0090) **Sandia Laboratories technical capabilities safety and reliability assurance.** (Sandia Labs., Albuquerque, N.Mex. (USA)). Dec 1975. Contract AT(29-1)-789. 12p. Dep. NTIS $3.50.

The safety and reliability assurance capabilities at Sandia Laboratories are characterized. Selected applications of these capabilities are presented to illustrate the extent to which they can be applied in research and development programs. (auth)

7110 (SAND—75-0412) **Electromagnetic Environments Simulator (EMES).** Varnado, G.B. (Sandia Labs., Albuquerque, N.Mex. (USA)). Nov 1975. Contract AT(29-1)-789. 112p. Dep. NTIS $5.45.

A multipurpose electromagnetic environments simulator has been designed to provide a capability for performing EMR, EMP, and lightning near stroke testing of systems, subsystems and components in a single facility. This report describes the final facility design and presents the analytical and experimental verification of the design. (auth)

7111 (SAND—75-0421) **Optimum frequency for communication between a buried coil and the Earth's surface.** Caffey, T.W.H. (Sandia Labs., Albuquerque, N.Mex. (USA)). Dec 1975. Contract AT(29-1)-789. 23p. Dep. NTIS $4.50.

Communication between two horizontal coils, one buried in a homogeneous earth and one upon the surface, is considered. It is shown that the frequency which maximizes the voltage induced in the receiving coil is that which makes the transmission path approximately a half-wavelength once a condition of minimum burial depth is met. Simple formulas are given for both the maximum voltage and the optimum frequency, and the error in the formulas is shown to be less than 10 percent. (auth)

7112 (SAND—75-0444) **Algorithm for determining survival probabilities for systems with redundant components.** Carson, C.C. (Sandia Labs., Albuquerque, N.Mex. (USA)). Dec 1975. Contract AT(29-1)-789. 15p. Dep. NTIS $3.50.

A simple and efficient algorithm for computing the survival probabilities for systems with redundant components (e.g., tactical aircraft in a AAA environment) is presented. The basis for construction of the algorithm and discussion of various aspects of it are included. (auth)

7113 (SAND—75-8055) **Orientation effects on environmental stability of sintered flow-control devices.** German, R.M. (Sandia Labs., Albuquerque, N.Mex. (USA)). Dec 1975. Contract AT(29-1)-789. 30p. Dep. NTIS $5.00.

Sintered flow-control devices operating in the 10^{-4}cm^3(He STP)/s range were subjected to moderately adverse environmental tests. Flow-rate stability was found to be orientation-dependent in only one case. A modified device incorporating protective open-porosity regions around the critical flow paths is shown to be a superior design, for which tests in water vapor and oil vapor show an improved flow stability worthy of consideration for future applications. Also, preliminary tests on platinum sintered flow-control devices indicate that this material may be an acceptable alternative (should one become necessary) to the present 304L stainless steel. (auth)

7114 (STI/PUB—402) **Radiation for a clean environment. Proceedings series. Proceedings of the international symposium held in Munich, Germany, March 17—21, 1975.** (International Atomic Energy Agency, Vienna (Austria)). Aug 1975. 682p. (In Russian and English). (CONF-750316—). IAEA $41.00.

From Symposium on the use of high level radiation in waste treatment status and prospects; Munich, F.R. Germany (17 Mar 1975).

Forty-eight papers on the use of high-level radiation in treating municipal and industrial wastes were presented at the conference. A separate abstract was prepared for each of 43 papers. Three of the papers are also announced in ERDA Research Abstracts (ERA). The remaining papers were not in scope for NSA or ERA. (LCL)

7115 (UCRL—13668) **Development of a design basis tornado and structural design criteria for the Nevada Test Site, Nevada. Final report.** McDonald, J.R.; Minor, J.E.; Mehta, K.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jun 1975. 64p. Dep. NTIS $4.50.

In order to evaluate the ability of critical facilities at the Nevada Test Site to withstand the possible damaging effects of extreme winds and tornadoes, parameters for the effects of tornadoes and extreme winds and structural design criteria for the design and evaluation of structures were developed. The meteorological investigations conducted are summarized, and techniques used for developing the combined tornado and extreme wind risk model are discussed. The guidelines for structural design include methods for calculating pressure distributions on walls and roofs of structures and methods for accommodating impact loads from wind-driven missiles. Calculations for determining the design loads for an example structure are included. (LCL)

7116 (WAPD-TM—1105) **Determination of stiffness and loading in bolted joints having circular geometry.** Sharp, G.R. (Bettis Atomic Power Lab., West Mifflin, Pa. (USA)). Nov 1975. Contract E(36-1)-GEN-14. 51p. Dep. NTIS $5.00.

A synthesized technique to aid in predicting the overall dynamic or static response of a bolted connection to externally applied dynamic or static tractions is presented. The technique is a synthesis of an existing method for determining stiffness coefficients in a bolted connection together with concepts and analysis techniques presented in this document. The information presented is considered a "first step" in the development of an analytical technique for predicting the overall stiffness of a bolted connection having circular geometry. (auth)

7117 (ERDA-tr—88) **Investigation of thermal stresses.** Prigorovskii, N.I. (ed.). 1972. Translated from Russian report. 322p. Dep. NTIS $9.75.

The collection gives the results of developing and employing new methods of determining thermal stresses in parts of machines and structures. Methods of modeling thermal stresses according to a given thermal field and extensometric methods and means of full-scale investigations during steady and variable thermal regimes are examined. The cited results may be used by scientific associates and specialists working in the field of rigid-body mechanics, and in investigating and calculating stresses in the parts of machines and structures. (auth)

7118 (ORNL-tr—2996) **Numerical analysis of the magnetic field of an alternator by finite elements and nonlinear point superrelaxation.** Glowinski, R.; Marrocco, A. Translated by M. Gerrard from *Comput. Methods Appl. Mech. Eng.;* 3: No. 55-85, 1974(1 Jun 1973). 25p. Dep. NTIS $4.25.

A method of solution of the two-dimensional non-linear partial differential equation describing the magnetic state in the cross-section of an alternator is presented. The method used is based on the combination of finite element technique with various non-linear successive point overrelaxation algorithms. A method is described that is very robust and efficient and gives the possibility

of solving easily, even on middle-size computers, the previous problem on complicated geometries. Convergence proofs for the finite element approximation and iterative algorithms are given. (auth)

7119 Alternative high-level radiation sources for sewage and waste-water treatment. Ballantine, D.S. (Energy Research and Development Administration, Washington, DC). pp 309-323 of In Radiation for a clean environment. Vienna; International Atomic Energy Agency (1975).

From Symposium on the use of high level radiation in waste treatment status and prospects; Munich, F.R. Germany (17 Mar 1975).

See STI/PUB—402; CONF-750316—.

The choice of an energy source for the radiation treatment of waste-water or sludge is between an electron accelerator or a gamma-ray source of radioactive cobalt or cesium. A number of factors will affect the ultimate choice and the potential future adoption of radiation as a treatment technique. The present and future availability of radioactive sources of cobalt and cesium is closely linked to the rate of nuclear power development and the assumption by uranium fuel reprocessors of a role as radioactive cesium suppliers. Accelerators are industrial machines which could be readily produced to meet any conceivable market demand. For energy sources in the 20 to 30 kW range, electron accelerators appear to have an initial capital cost advantage of about seven and an operating cost advantage of two. While radioisotope sources are inherently more reliable, accelerators at voltages to 3 MeV have achieved a reliability level adequate to meet the demands of essentially continuous operations with moderate maintenance requirements. The application of either energy source to waste-water treatment will be significantly influenced by considerations of the relative penetration capability, energy density and physical geometrical constraints of each option. The greater range of the gamma rays and the lower energy density of the isotopic sources permit irradiation of a variety of target geometrics. The low penetration of electrons and the high-energy density of accelerators limit application of the latter to targets presented as thin films of several centimeters thickness. Any potential use of radiation must proceed from a clear definition of process objectives and critical comparison of the radiation energy options for that specific objective. (auth)

7120 Considerations in the public acceptance of sewage sludge irradiation systems. Dix, G.P. (Atomic Energy Commission, Washington, DC). pp 399-408 of In Radiation for a clean environment. Vienna; International Atomic Energy Agency (1975).

From Symposium on the use of high level radiation in waste treatment status and prospects; Munich, F.R. Germany (17 Mar 1975).

See STI/PUB—402; CONF-750316—.

Considerations associated with public acceptance of municipal sewage sludge irradiation systems are discussed including the benefit to society, public information and safeguards. Public acceptance of products is based upon the benefit to society as measured by reduced consumer costs, minimization of public risk and enhancement of the quality of life and the environment. When viewed in this positive light, the sludge irradiator has high potential benefits to the community. If large-scale engineering experiments show that sludge irradiation is more cost-effective than other methods, reduced consumer costs would result. Today many sewage plants do not consistently remove pathogens from sludge; sludge irradiation could be an effective method of pathogen removal and result in avoidance of a major public risk. The sludge irradiator may be able to clean up recreational areas, reduce noxious odors from sewage treatment facilities, and reduce the energy requirements for producing fertilizer and soil conditioners and conserve their mineral content. Plant safeguards must be explained to dispel public concern that the contents of the source can be released to the sludge accidentally. This will be the main issue within the technical sector of the public, and the design, procedural and administrative safeguards of the plant must be fully explained. The primary risk associated with sludge irradiators will be the remote possibility of source leakage into the sludge. The various safeguards in sludge irradiation plants are discussed in detail including the form of the radionuclide, encapsulation, the irradiation chamber, safeguards instrumentation, shielding and thermal safeguards. (auth)

7121 Apparatus for blending small particles. Bradley, R.A.; Reese, C.R.; Sease, J.D. (to U.S. Energy Research and Development Administration). US Patent 3,901,409. 26 Aug 1975. Filed date 23 Jul 1974. 6p.

PAT-APPL-491,096.

An apparatus is described for blending small particles and uniformly loading the blended particles in a receptacle. Measured volumes of various particles are simultaneously fed into a funnel to accomplish radial blending and then directed onto the apex of a conical splitter which collects the blended particles in a multiplicity of equal subvolumes. Thereafter the apparatus sequentially discharges the subvolumes for loading in a receptacle. A system for blending nuclear fuel particles and loading them into fuel rod molds is described in a preferred embodiment. (auth)

CRYOGENIC AND SUPERCONDUCTING EQUIPMENT AND DEVICES

7122 (LA-UR—75-2199) **Quantitative studies of magnetic cooling on a magnetic system which obeys the third law.** Johnson, J.D.; Bonner, J.C. (Los Alamos Scientific Lab., N.Mex. (USA)). 1975. Contract W-7405-ENG-36. 9p. (CONF-751209—10). Dep. NTIS $4.50.

From 21. annual conference on magnetism and magnetic materials; Philadelphia, Pennsylvania, USA (9 Dec 1975).

Quantitative estimates of magnetic cooling in ferro-(para-) and antiferromagnets have not been feasible in the past because the standard theoretical models and approaches all disobey the third law of thermodynamics and are consequently unreliable at low temperatures. Recently, an essentially exact treatment has been developed for the linear anisotropic Heisenberg—Ising chain, the only solvable model which does obey the third law. Novel and complex features in the cooling behavior of the antiferromagnet are observed, and arguments are presented to indicate that quasi-(1-D) magnetic systems may turn out to be serious rivals to the classic cooling paramagnets like CMN. (auth)

7123 (ORNL-TM—5187) **Survey of radiation damage effects in superconducting magnet components and systems.** Guess, J.F.; Boom, R.W.; Coltman, R.R. Jr.; Sekula, S.T. (Oak Ridge National Lab., Tenn. (USA)). Dec 1975. Contract W-7405-eng-26. 42p. Dep. NTIS $5.00.

A study has been made of the published investigations of fast-particle irradiations at low temperatures on the properties of likely CTR magnet materials. The materials topics included in this survey are: (1) irradiation of Nb-Ti alloys with fast neutrons, protons, deuterons, and electrons; (2) irradiation of A-15 compounds (mainly Nb_3Sn) with fast neutrons, deuterons, and oxygen ions; (3) irradiation of Cu and Al with fast and thermal neutrons; (4) irradiation of insulators with neutrons and gamma rays; and (5) irradiation of structural materials with neutrons. The study of the literature also included the available information on the effects of low-temperature irradiation on integrated components of the materials described above which might be envisaged in the construction of a CTR magnet system, since the ultimate problem is the operation of a magnet system in a radiation environment. (TFD)

7124 (ERDA-tr—85) **Current transformation and field screening with superconducting coils.** Scherer, M.; Turowski, P. Translation of KFK—2064 24p. Dep. NTIS $3.50.

Investigations on the inductive generation of electrical currents in superconducting coils are reported. The induced currents are limited by the I/sub c/, B curve of the superconductor so that they break down at certain values of magnetic field. After each breakdown, a current is induced again if the field increases continuously. From an examination of the current field values at the breakdown points, the I/sub c/, B curve for the superconducting material can be derived. As a maximum, currents of 4000 A were induced in a coil made of superconducting cable. Inductive screening of a magnetic field by a superconducting coil is correlated with a negative field in the center. (auth)

7125 (ERDA-tr—79) **Applications of superconducting magnets. Part 1.** Karlsruhe, W.H. Translated from *Phys. Bl.;* No. 5, 197-207(1949). 13p. Dep. NTIS $4.50.

The theory, construction, and operation of superconducting magnets are reviewed. The uses of superconducting magnets are discussed under the following topics: high field research; superconducting magnets in the middle field range as economic alternatives; detection magnets; beam guidance magnets; pulsed superconducting magnets; superconducting shield magnet; and magnets with great field constancy. (TFD)

7126 Small, low internal volume valve, and a low temperature bellows-sealed needle valve. Oversluizen, T. (Brookhaven National Lab., Upton, NY). *Rev. Sci. Instrum.;* **46**: No. 6, 788-789(Jun 1975).

Two valves are described: (1) a small regulating valve with an internal volume of 0.24 cm^3 which uses some commercially available parts and is used in high pressure ^3He gas handling systems, and (2) a high pressure bellows-sealed valve for low temperature applications, including superfluid ^4He. (auth)

7127 Electrically insulating feed-through for cryogenic applications. Bemberger, J.A.; Brown, D.P.;. (to U.S. Energy Research and Development Administration). US Patent 3,904,815. 9 Sep 1975. Filed date 17 Sep 1974. 4p.
PAT-APPL-506,818.
This patent relates to an electrical connector (suitable for cryogenic applications) of virtually all metal construction employing anodized aluminum rings to provide electrical isolation. (auth)

PROTECTIVE STRUCTURES AND EQUIPMENT

7128 (LA—6074-PR) **Multiple HEPA filter test methods, July 1, 1974—March 31, 1975.** Schuster, B.G.; Osetek, D.J. (Los Alamos Scientific Lab., N.Mex. (USA)). Aug 1975. Contract W-7405-ENG-36. 8p. Dep. NTIS $4.00.
A laboratory apparatus has been constructed for testing two HEPA filters in a series configuration. The apparatus consists of an instrumented wind tunnel in which the HEPA filters are mounted, and an auxiliary wind tunnel for obtaining diluted samples of the challenge aerosol upstream of the first filter. Measurements performed with a single particle aerosol spectrometer demonstrate the capability for measuring overall protection factors of greater than 2.5×10^8. The decay of penetration as a function of time in individual HEPA filters indicates no preferential size discrimination in the range of 0.1 μm to 1.0 μm; nor is there a preferential size discrimination of penetration in this same range. A theoretical feasibility study has been performed on the use of an inhomogeneous electric field/induced aerosol electric dipole interaction for potential use as an air cleaning mechanism. Numerical evaluation of a coaxial cylinder geometry indicates that the method is feasible for collection of particles down to 0.1 μm under typical airflow velocity conditions. Small modifications in the geometry may be incorporated to create an instrument capable of measuring particle size. Geometries other than coaxial cylinders are also under investigation. (auth)

7129 (UCID—16949-75-3) **Enhanced filtration, July—September 1975 progress report. Project No. 3026.** Nelson, G.O.; Richards, C.P. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 5 Nov 1975. Contract W-7405-Eng-48. 18p. Dep. NTIS $4.00.
Progress during July to October 1975 in improving the service life of high-efficiency particulate air filters is described. The design and operation of filter testing equipment including sodium chloride aerosol generator, particle agglomerator, electronic differential pressure manometer, and flame photometric sodium detector are discussed. (LCL)

HANDLING EQUIPMENT AND PROCEDURES

7130 (LA—3067-MS(Rev.)) **Los Alamos critical-mass data.** Paxton, H.C. (Los Alamos Scientific Lab., N.Mex. (USA)). Nov 1975. Contract W-7405-ENG-36. 57p. Dep. NTIS $5.50.
The original version of this report tabulates critical masses of simple systems, which have been measured through the year 1963. This revision adds data through October 1975, and modifies some of the old critical specifications that have been reevaluated. The old format and symbolism are retained to simplify reproduction.

7131 (ORNL-TM—5113) **Comparison of Hansen—Roach and ENDF/B-IV cross sections for ^{233}U criticality calculations.** McNeany, S.R.; Jenkins, J.D. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 21p. Dep. NTIS $5.00.
A comparison is made between criticality calculations performed using ENDF/B-IV cross sections and the 16-group Hansen— Roach library at ORNL. The area investigated is homogeneous systems of highly enriched ^{233}U in simple geometries. Calculations are compared with experimental data for a wide range of H/^{233}U ratios. Results show that calculations of k/sub eff/ made with the Hansen—Roach cross sections agree within 1.5 percent for the experiments considered. Results using ENDF/B-IV cross sections were in good agreement for well-thermalized systems, but discrepancies up to 7 percent in k/sub eff/ were observed in fast and epithermal systems. (auth)

SHIPPING CONTAINERS

7132 (BNL—20538) **Evaluation of the HFBR fuel shipping cask versus requirements of ERDAM 0529. Informal report.** Bezler, P.; Milau, J. (Brookhaven National Lab., Upton, N.Y. (USA)). Jul 1974. vp. Dep. NTIS $7.60.
The HFBR Spent Fuel Shipping Cask as modified for shipping longer fuel elements is described in detail and evaluated against ERDAM 0529 standards for packaging; structural integrity under uniform loading or external pressure; criticality; normal transport conditions; hypothetical accident conditions; quality assurance; and operating procedures. (LCL)

7133 (DPSPU—75-124-1) **Safety analysis report: packages. Argonne National Laboratory SLSF test train shipping container, P-1 shipment. Fissile material. Final report .** Meyer, C.A. (comp.). (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Lab.). Jun 1975. Contract AT(07-2)-1. 61p. Dep. NTIS $4.50.
The package is used to ship an instrumented test fuel bundle (test train) containing fissile material. The package assembly is Argonne National Laboratory (ANL) Model R1010-0032. The shipment is fissile class III. The packaging consists of an outer carbon steel container into which an inner container is placed; the inner container is separated from the outer container by urethane foam cushioning material. The test train is supported in the inner container by a series of transverse supports spaced along the length of the test train. Both the inner and outer containers are closed with bolted covers. The covers do not seal the containers in a leaktight manner. The gross weight of the shipment is about 8350 lb. The unirradiated fissile material content is less than 3 kg of UO_2 of up to 93.2 percent enrichment. This is a Type A quantity (transport group III and less than 3 curies) of radioactive material which does not require shielding, cooling or heating, or neutron absorption or moderation functions in its packaging. The maximum exterior dimensions of the container are 37 ft 11 in. long, 24 1/2 in. wide, and 19 3/4 in. high. (TFD)

7134 (ORNL-TM—4905) **Safety analysis report for packaging Lawrence Livermore Laboratories shipping containers.** Evans, J.H. (Oak Ridge National Lab., Tenn. (USA)). Dec 1975. Contract W-7405-eng-26. 191p. Dep. NTIS $7.60.
The Lawrence Livermore Laboratories shipping containers were designed at Oak Ridge National Laboratory for use in transporting weapons and nuclear components. The design for the containers was evaluated to show compliance with applicable regulations governing packages in which radioactive and fissile materials are transported. Computational procedures were used to determine the structural integrity and thermal behavior of the containers relative to the standards for the normal conditions of transport. A full-scale container test model was destructively tested to verify compliance with the standards for the accident conditions. The results of the analytical evaluations and the tests demonstrate that the design for the Lawrence Livermore Laboratories shipping containers is in compliance with the applicable regulations. (auth)

7135 (SAND—75-0062) **Accident-resistant container: safety for warhead transport. Executive summary.** Berry, R.E. (Sandia Labs., Albuquerque, N.Mex. (USA)). Nov 1975. Contract AT(29-1)-789. 21p. Dep. NTIS $4.00.
Development testing of model and full-scale hardware to the abnormal environments created during a cargo aircraft crash has demonstrated that the accident-resistant container (ARC) can protect an enclosed warhead from these abnormal environments. This protection reduces the probability of initiation of the warhead HE. Transfer of the plutonium limit to the ARC may permit transporting increased numbers of warheads on a single transport vehicle. Testing of one warhead configuration has been completed. Production can be initiated for transporting that system in the ARC. Other systems need test evaluation and certification before being transported in the ARC. (auth)

7136 (SAND—75-5986) **Technology development program for safe shipment of spent fuel from liquid metal fast breeder reactor.** Freedman, J.M.; Humphreys, J.R. (Sandia Labs., Albuquerque, N.Mex. (USA)). Oct 1975. 11p. (CONF-760104—2). Dep. NTIS $4.50.
From Annual meeting of the transportation research board; Washington, District of Columbia, USA (19 Jan 1976).
A comprehensive plan to develop shipping cask technology is described. Technical programs in the disciplines of heat transfer, structures and containment, spent fuel characterization, hot laboratory verification, shielding, and hazards analysis are discussed. Both short- and long-term goals in each discipline are delineated and how the disciplines interrelate is shown. The technologies developed will be used in the design, fabrication, and testing of truck-mounted and rail-car casks. These casks will be used for safely transporting short-cooled, high-burnup Liquid Metal Fast Breeder Reactor (LMFBR) spent fuel from reactors to reprocessing plants. (auth)

LASERS

7137 (LA—6124-MS) **Very high intensity reaction chamber design.** Devaney, J.J. (Los Alamos Scientific Lab., N.Mex. (USA)). Sep 1975. Contract W-7405-ENG-36. 14p. Dep. NTIS $4.00.

The problem of achieving very high intensity irradiation by light in minimal regions was studied. Three types of irradiation chamber are suggested: the common laser-reaction chamber, the folded concentric or near-concentric resonator, and the asymmetric confocal resonator. In all designs the ratio of high-intensity illuminated volume to other volume is highly dependent (to the $^3/_2$ power) on the power and fluence tolerances of optical elements, primarily mirrors. Optimization of energy coupling is discussed for the common cavity. For the concentric cavities, optimization for both coherent and incoherent beams is treated. Formulae and numerical examples give the size of chambers, aspect ratios, maximum pass number, image sizes, fluences, and the like. Similarly for the asymmetric confocal chamber, formulae and numerical examples for fluences, dimensions, losses, and totally contained pass numbers are given. (auth)

7138 (UCRL—13660) **Fluorescence line-narrowing studies of Nd:glass laser materials.** Riseberg, L.A.; Brecher, C. (GTE Labs., Inc., Waltham, Mass. (USA)). [nd]. Contract W-7405-Eng-48. 51p. (TR—75-029.1). Dep. NTIS $5.50.

The increasing importance of Nd glass lasers in laser fusion technology has emphasized the inadequacy in the understanding of the optical properties of rare earth ions in glasses. Indeed, it has been difficult to generate models for the performance of these devices, and the selection of host glasses could be done by little more than a trial-and-error approach. The technique of laser-induced fluorescence line-narrowing developed within the last few years provides a new and powerful tool for the study of these systems. In this technique, a laser excites within the inhomogeneously broadened absorption bands a selected subgroup of the ions in the system, namely those whose absorption energy is resonant with the laser. If the excitation does not migrate among the entire collection of ions prior to fluorescence, the fluorescence that is observed is only from the group that was excited and is narrowed. This permits the selective study of classes of ion sites within the ensemble. The concept is indicated schematically. By the use of a tunable laser, such as a dye laser, it is possible to vary the class of sites, defined by energy, that is excited and thereby study the important spectroscopic properties and their variations, unclouded by the averaging that occurs under excitation of the entire system. Furthermore, it is then possible to use the spectroscopic information to infer a description of the variation of the microscopic environment, and a rationalization of the effects of compositional changes. Use of a pulsed dye laser and time-resolved detection permits the study of the dynamics, including, for example, the energy transfer among ions of different energies within the inhomogeneously-broadened spectrum. The goal of this project has been to apply such studies to glasses of interest to glass laser technology, providing information for device modeling, and establishing design criteria for glass selection. (auth)

7139 (UCRL—51931) **Numerical investigation of the pulsed NF3 + H2 chemical laser using a model which includes rotational relaxation and semi-classical laser equations.** Creighton, J.R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Sep 1975. Contract W-7405-Eng-48. 314p. Dep. NTIS $9.75.

Thesis.

Waveforms and population distributions have been calculated by a numerical model and compared with experiment for an electric-discharge-initiated, pulsed $NF_3 + H_2$ chemical laser. The model treats each vibrational-rotational state separately, allowing rotational relaxation between adjacent states as well as vibrational relaxation and lasing according to P-branch selection rules. Calculated waveforms agree with experiment and show several features not seen when rotational equilibrium is assumed: simultaneous lasing on many transitions, cascade behavior, spikes due to laser relaxation oscillations, non-Boltzmann rotational distributions, and "hole burning" in the population distributions. The calculations give insight into the physical phenomena governing the shape and duration of the waveforms. The effect of varying certain parameters, relaxation rates, temperature, pressure, and diluents, is studied. Best fit to experimental waveforms is obtained when the rotational relaxation rate and collisional line broadening rate are approximately equal at about 10 times the hard sphere collision rate. The IXION computer code, developed for these calculations, is described in detail. In addition, an analytic model is presented which accounts for major features of the total (all transitions) output waveform of the laser assuming rotational equilibrium, a steady state laser model, and constant temperature. A second computer code, MINOTAR, was developed as a general purpose chemical kinetics code. It verifies the analytic model and extends the results to adiabatic reactions where the temperature varies, and can yield waveforms using the assumptions of rotational equilibrium and a steady state laser. The MINOTAR code, being general, can also be used for chemical kinetics problems such as air pollution and combustion. (auth)

7140 (UCRL—77561) **Proceedings of the meeting for coordinating precision machining of optics research and requirements.** Saito, T.T. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Dec 1975. Contract W-7405-Eng-48. 22p. (CONF-750998—1). Dep. NTIS $4.50.

From Meeting for coordinating precision machining of optics; Kirtland AFB, New Mexico, USA (18 Sep 1975).

The meeting for "Coordinating Precision Machining of Optics Research and Requirements" on September 18, 1975, was sponsored by the Air Force Weapons Laboratory at Kirtland AFB, NM. These proceedings contain an introduction to the meeting including a brief description of the participants and the objectives. The developments and capabilities of Union Carbide Y-12 plant are described in detail. A short summary of the new Moore no. 5 machine at Bendix, Kansas City, Mo. is included as well as a description of using light scattering for roughness characterization at Rockwell International, Rocky Flats, Colorado. The executive summary of the meeting mentions some of the discussions that also followed. Important conclusions of the meeting were that a 5 y lead time is required to obtain a machine and acquire the necessary skills for precision machining, and that demands for diamond turning optics will be increasing. (auth)

7141 (Y-DA—6328) **Optical measurements of surface quality and figure of diamond-turned mirrors.** Sladky, R.E.; Dean, R.H. (Oak Ridge Y-12 Plant, Tenn. (USA)). 1975. Contract W-7405-eng-26. 17p. (CONF-750748—2). Dep. NTIS $4.50.

From 7. NBS-ONR-ASTM symposium on damage in laser materials; Boulder, Colorado, USA (30 Jul 1975).

During the past year, the Oak Ridge Y-12 Plant has made mirrors, by diamond turning, for the LASL High-Energy Laser and other projects. The largest of these mirrors is flat, elliptical in shape, and 654 mm (25.5 in) on the major axis and 394 mm (15.5 in) on the minor axis. The concave mirrors are 394 mm OD. These mirrors were inspected for surface finish and figure. In addition, the blur circle was measured. Measurements of scattered light have also been made. In some cases, the diffraction pattern was related to the waves formed in the surface by the machining process. This information has been useful to engineers doing research on the diamond turning of laser materials. (auth)

7142 (Y-DA—6346) **Slide-position errors degrade machined optical component quality.** Arnold, J.B.; Steger, P.J.; Burleson, R.R. (Oak Ridge Y-12 Plant, Tenn. (USA)). 12 Dec 1975. Contract W-7405-eng-26. 27p. (CONF-750748—1). Dep. NTIS $5.00.

From 7. NBS-ONR-ASTM symposium on damage in laser materials; Boulder, Colorado, USA (30 Jul 1975).

An ultraprecision lathe is being developed at the Oak Ridge Y-12 Plant to fabricate optical components for use in high-energy laser systems. The lathe has the capability to produce virtually any shape mirror which is symmetrical about an axis of revolution. Two basic types of mirrors are fabricated on the lathe, namely: (1) mirrors which are machined using a single slide motion (such as flats and cylinders), and (2) mirrors which are produced by two-coordinated slide motions (such as hyperbolic reflectors; large, true-radius reflectors, and other contoured-surface reflectors). The surface-finish quality of typical mirrors machined by a single axis of motion is better than 13 nm, peak to valley, which is an order of magnitude better than the surface finishes of mirrors produced by two axes of motion. Surface finish refers to short-wavelength-figure errors that are visibly detectable. The primary cause of the inability to produce significantly better surface finishes on contoured mirrors has been determined as positional errors which exist in the slide positioning systems. The correction of these errors must be accomplished before contoured surface finishes comparable to the flat and cylinder can be machined on the lathe. (auth)

7143 (LA-tr—75-42) **Frequency tunable lasers.** Kushida, T. Translated from *Bunko Kenkyu;* **21**: No. 2, 67-81(1972). 19p. Dep. NTIS $3.50.

A review of tunable lasers is presented. The lasers considered include dye lasers, optical parametric oscillators, semiconductor lasers, and Raman lasers. (TFD)

7144 **Hydrogen fueled gas dynamic laser.** Cavalleri, R.J. (Atlantic Research Corp., Alexandria, VA). pp 677-684 of In Hydrogen energy. Part B. Veziroglu, T.N. (ed.). New York; Plenum Publishing Corp. (1975).

From Hydrogen economy Miami energy conference; Miami Beach, Florida, USA (18 Mar 1974).

See CONF-740306—PB.

The physics behind a conventional CO_2 Gas Dynamic Laser are briefly described. Recent improvements in GDL technology have shown a possible threefold improvement for CO_2 GDL's. The extension of this technology to a hydrogen fueled laser is discussed. The preliminary indications are that for a hydrogen laser, an order of magnitude improvement is possible. (auth)

7145 Laser induced damage in optical materials: 6th ASTM symposium. Glass, A.J.; Guenther, A.H. (Lawrence Livermore Lab., CA). *Appl. Opt.*; **14**: No. 3, 698-715(Mar 1975).

From 6. ASTM symposium; Boulder, CO (Mar 1975).

The Sixth ASTM-ONR-NBS Symposium on Laser Induced Damage in Optical Materials was held at the National Bureau of Standards in Boulder, Colorado on 22-23 May 1974. Over 150 attendees at the Symposium heart thirty-one papers on topics relating to laser induced damage in crystalline and nonlinear optical materials, at dielectric surfaces, and in thin film coatings as well as discussions of damage problems in the ir region due both to cw and pulsed irradiation. In addition, several reports on the theoretical analysis of laser-materials interaction relative to the damage progress were given, along with tabulations of fundamental materials properties of importance in evaluation of optical material response to high-power laser radiation. Attention was given to high-power laser system design considerations that relate to improved system performance and reliability when various damage mechanisms are operable in such systems. A workshop on the machining of optics was held, and nine papers on various facets of the topic were presented dealing with machining procedures, surface characterization of machined elements, coating of machined components, and the polishing and damage resistance of polished, coated, and bare metal reflectors. (auth)

7146 Coaxial short pulsed laser. Nelson, M.A.; Davies, T.J. (to U.S. Energy Research and Development Administration). US Patent 3,898,586. 5 Aug 1975. Filed date 8 Jan 1974. 8p.

PAT-APPL-431,817.

This invention relates to a laser system of rugged design suitable for use in a field environment. The laser itself is of coaxial design with a solid potting material filling the space between components. A reservoir is employed to provide a gas lasing medium between an electrode pair, each of which is connected to one of the coaxial conductors. (auth)

7147 Nonradiative relaxation of rare-earth ions in silicate laser glass. Layne, C.B.; Lowdermilk, W.H.; Weber, M.J. (Univ. of California, Livermore). *IEEE J. Quant. Electron.*; **QE-11**: No. 9, 798-800(Sep 1975).

Rates for nonradiative decay by multiphonon emission are measured for rare-earth ions in silicate laser glass and used to estimate quantum efficiencies. (auth)

7148 Explosive laser. Robinson, C.P.; Jensen, R.J.; Davis, W.C.; Sullivan, J.A. (to U.S. Energy Research and Development Administration). US Patent 3,904,985. 9 Sep 1975. Filed date 5 Feb 1974. 12p.

PAT-APPL-439,793.

This patent relates to a laser system wherein reaction products from the detonation of a condensed explosive expand to form a gaseous medium with low translational temperature but high vibration population. Thermal pumping of the upper laser level and de-excitation of the lower laser level occur during the expansion, resulting in a population inversion. The expansion may be free or through a nozzle as in a gas-dynamic configuration. In one preferred embodiment, the explosive is such that its reaction products are CO_2 and other species that are beneficial or at least benign to CO_2 lasing. (auth)

7149 Apodised aperture using rotation of plane of polarization. Simmons, W.W.; Leppelmeier, G.W.; Johnson, B.C. (to U.S. Energy Research and Development Administration). US Patent 3,904,273. 9 Sep 1975. Filed date 18 Mar 1974. 4p.

PAT-APPL-452,165.

An apodised aperture based on the rotation of plane of polarization producing desirable characteristics on a transmitted light beam such as beam profiling in high flux laser amplifier chains is described. The apodised aperture is made with a lossless element by using one or more polarizers and/or analyzers and magneto-optical Faraday means for selectively rotating the plane of polarized radiation over the cross section to effect the desired apodisation. (auth)

7150 Laser-initiated krypton-switched Blumlein structure for pulse selection. Hyer, R.C.; Sutphin, H.D.; Winn, K.R. (Los Alamos Scientific Lab., NM). *Rev. Sci. Instrum.*; **46**: No. 10, 1333-1334(Oct 1975).

A method is described for the selection of a mode-locked pulse from a laser by the use of a laser-initiated krytron-switched Blumlein structure that replaces the usual high voltage spark gap. The main features are an all electronic circuit coupled to a longitudinal mode KD*P Pockels cell that has a fast risetime and high extinction ratio. The result is an inexpensive, noise-free pulse selector that provides a stable source of switched out pulses. (auth)

7151 Xenon-dimer-laser net-gain measurements. Johnson, A.W.; Gerardo, J.B. (Sandia Laboratories, Albuquerque, New Mexico 87115). *J. Appl. Phys.*; **46**: No. 11, 4870-4874(Nov 1975).

The gain of the vacuum-ultraviolet xenon-dimer laser was evaluated by employing a double-pass technique with spectral filtering of the probe radiation. At the wavelength center of the continuum-emission spectrum ($\lambda_0 \cong 1720$ A), the net-gain coefficient at pressures less than 1.1×10^4 Torr was found to be $g_0 = (1.05 \pm 0.2) \times 10^{25}$ P/sub s/cm^{-1}, where P/subs/ is the spontaneous-emisssion intensity of the continuum-emission band in units of photons/sec cm^3. By comparison of laser-output waveforms with temporally resolved net-gain measurements, it is shown that the laser intensity is limited by an unidentified time-dependent loss mechanism that is either foreign to the excited medium or that is driven by the laser radiation. While we do not know the source of this mechanism, our observations show that this time-dependent loss mechanism is not associated with the lasing states of the xenon dimer. At very high pressures ($>1.3 \times 10^4$ torr) the effects of photoscattering by the background xenon were found to reduce the value of g_0. (AIP)

7152 Amplification of multiline/multiband CO_2 laser pulses. Figueira, J.F.; Ladish, J.S.; Schappert, G.T.; Thomas, S.J. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87544). *Appl. Phys. Lett.*; **27**: No. 11, 591-592(1 Dec 1975).

Amplification measurements of single-line and multiline/multiband nanosecond CO_2 laser pulses are reported. It is shown that at amplifier pressures of 600 Torr the saturation energy for multiline pulses is twice as large as for single-line pulses. (AIP)

HEAT TRANSFER AND FLUID FLOW

7153 (ENSAM—74-5, pp 8-33) **Flow of a partially vaporizing liquid in a duct with a constant cross section.** Vivier, L. 1974. (In French).

In Ecole Nationale Superieure d'Arts et Metiers. Scientific and technical publications. 1974-5.

The flow rate due to an accidental clean failure in a vaporizing bundle tube of steam generator is derived. The optimal diameter of a pipe of drain transfer of the feedwater heaters in a thermal power plant was also calculated. (FR)

7154 (SAND—75-8733) **Rough wall turbulent heat transfer with variable velocity, wall temperature, and blowing.** Coleman, H.W.; Pimenta, M.M.; Moffat, R.J. (Sandia Labs., Livermore, Calif. (USA)). Nov 1975. Contract AT(29-1)-789. 10p. (CONF-760102—2). Dep. NTIS $4.50.

From 14. AIAA aerospace sciences meeting; Washington, District of Columbia, USA (26 Jan 1976).

An integral prediction method is presented which accurately describes Stanton number behavior for a fully rough turbulent boundary layer flowing over a uniformly rough surface. The kernel function which represents the response of such a system to an unheated starting length is shown to also describe the response to variations in freestream velocity, surface temperature and blowing. Predictions are compared with experimental data for cases of variable wall temperature, favorable pressure gradients and variable blowing. Agreement is excellent in all cases. (auth)

7155 (ANL-Trans—994) **Heat transfer crisis in an individual evaporation channel.** Doroshchuk, V.E.; Lantsman, F.P.; Levitan, L.L.; Nigmatulin, B.I. Sep 1975. Translated from pp 27-44 of heat transfer crisis during heating in channels, Obninsk, USSR, 1974. 13p. Dep. NTIS $4.50.

Experiments performed to study the heat transfer crisis, or dryout, of steam-water flow in heated tubes and annuli are described. (LCL)

MATERIALS TESTING

7156 (ORNL—5065) **Theory and numerical calculation of the acoustic field exerted by eddy-current forces.** Kawashima, K. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 102p. Dep. NTIS $6.50.

The equations for calculating the acoustic field produced within a nonmagnetic metal by interaction of eddy currents with a static magnetic field were obtained on the assumptions (1) an ultrasonic wave is generated by the electromagentic force through classical and macroscopic phenomena; (2) the electric, magnetic, and elastic properties of the metal are linear, isotropic, and homogeneous throughout the metal, which occupies semi-infinite space; (3) the whole system is axially symmetric; and (4) eddy

currents and elastic waves show a steady-state sinusoidal variation. The acoustic field produced by a specific electromagnetic ultrasonic transducer with axial symmetry was calculated numerically, and the results showed a well-defined ultrasonic wave beam, which was narrower than had been expected from the size of the transducer. (auth)

7157 (ORNL—5099) **Nondestructive testing development quarterly progress report for period ending September 30, 1975.** Hill, M.R. (comp.). (Oak Ridge National Lab., Tenn. (USA)). Nov 1975. Contract W-7405-eng-26. 55p. AT.

Results collected during the period from July 1 to Oct. 1, 1975, in all nondestructive testing development programs sponsored by the Division of Reactor Research and Development of ERDA are reported. The results were obtained by the Argonne National Laboratory, General Electric Co., Hanford Engineering Development Laboratory, and Oak Ridge National Laboratory. (LCL)

7158 (UCRL-Trans—10728) **Sound emission analysis: a new non-destructive testing process.** Eisenblaetter, J. Translated from *Ing.-Dig.*; **11**: No. 10, (1972). 20p. Dep. NTIS $4.50.

Sound emission analysis is based on the following phenomenon: the sliding processes which take place during the deformation of a metal or the cracks growing in a material send out sound impulses whose frequencies range up to the ultrasound region. These sound impulses are measured with sensitive piezoelectric receivers. If several receivers are attached, e.g. to a large pressure vessel which is under stress by inner pressure, then it is possible to establish the time differences of the sound impulses among the different receivers and thus localize a crack as a source of sound, similar to the way in which the origin of an earthquake is determined. The deployment of sound emission analysis to a non-destructive test-procedure has already advanced so far that a number of interesting applications exist. This paper will describe the investigation of plastic deformation in metals, the localizing of flaws in the pressure test of large boilers, the discovery of evidence of special type of crack formation in tension arm annealing (underplating cracks) and the differentiation of various rupture processes in plastic strengthened by glass fibers. (auth)

SAFETY ENGINEERING

7159 (LA—6120-PR) **Ventilation systems analysis during tornado conditions. Progress report, January—June 1975.** Bennett, G.A.; Gregory, W.S.; Smith, P.R. (Los Alamos Scientific Lab., N.Mex. (USA)). Nov 1975. Contract W-7405-ENG-36. 22p. Dep. NTIS $4.00.

The principal concern of this investigation is to develop the capability to simulate the dynamic effects of a tornado depressurization on a ventilation system. The basic formulation and solution of the two-zone series model ventilation subsystem is based on lumped parameter component response equations, the isothermal compression of air, and the conservation of mass. Solutions based on these assumptions are also presented for the two-zone series model with natural bypass, the two-zone series model with recirculation, and the natural branching model. A parameter study is presented comparing the effects of changes in system resistance, system capacitance, and variable tornado depressurization rates. The adaptability of the basic formulation to adiabatic compression of air and the addition of duct resistance is examined. A quasi-steady formulation is introduced and preliminary considerations of the importance of inertia are presented. Preliminary conclusions in this area indicate that inertial effects can be neglected. For relatively long ducts slow shock development appears possible. Work on the effect of tornado depressurization rates as related to shock development and on the importance of inertia effects is continuing. (auth)

ELECTRONIC CIRCUITS AND DEVICES

7160 (BDX—613-1252(Rev.)) **Development of an improved bonding fixture.** Sheeley, J.D. (Bendix Corp., Kansas City, Mo. (USA)). Jan 1976. Contract AT(29-1)-613. 21p. Dep. NTIS $4.00.

A bonding-laminating fixture with self-contained heating, cooling, pressure, and vacuum features was developed. The fixture has a usable platen area of 24 by 36 in. (609.6 by 914.4 mm) and has a control panel which allows the bonding cycle to be programmed for automatic operation. The fixture is used to laminate adhesive-coated Mylar or Kapton to etched circuits. (auth)

7161 (BDX—613-1468) **Surface effects on semiconductors. Final report.** Rauch, E.L. (Bendix Corp., Kansas City, Mo. (USA)). Jan 1976. Contract AT(29-1)-613. 33p. Dep. NTIS $4.00.

Semiconductor bi-polar and field-effect transistors were contaminated with sodium ions, subjected to high temperature reverse bias, measured electrically, and examined internally to study the effects of inversion, depletion, and accumulation in crystalline silicon. This study was terminated because of the inability to induce electrical degradation through surface contamination at a level consistently high enough to permit statistically valid correlations and conclusions. (auth)

7162 (SU-SEL—75-049) **New philosophy for wire routing. Technical report No. 101.** Rau, B.R. (Stanford Univ., Calif. (USA). Stanford Electronics Labs.). Nov 1975. Contract AT(04-3)-326P.A.39. 42p. (SU—326P.39-6). Dep. NTIS $4.00.

A number of interconnection algorithms exist and have been used quite successfully. However, most of them, though differing in detail, appear to subscribe to the same underlying philosophy which has developed from that for single layer boards. Arguments are advanced which question the validity of this philosophy in the environment of multilayer board technology. A new philosophy is developed that will be more suited for use with multilayer boards. Based on this philosophy, an interconnection algorithm is then developed in a step by step fashion. (auth)

7163 (UCRL—50025-75-4, pp 20-23) **Subnanosecond MOS pressure switch greatly improves shock-wave-velocity measurements in the tera-pascal range.** 8 Oct 1975.

In Electronics Engineering Department quarterly report No. 4, 1975.

A metal-oxide-semiconductor (MOS) pressure switch capable of subnanosecond risetimes was developed. Two high-speed switches can be used to measure shock-wave velocities in the tera-pascal (TPa) pressure range with accuracy much greater than previously possible. This improved measurement capability promises to provide valuable information on materials properties for weapons development. The new switch and techniques of measuring extremely high shock-wave velocities are described. (auth)

7164 **Short-range radio-telemetry for electronic identification, using modulated rf backscatter.** Koelle, A.R.; Depp, S.W.; Freyman, R.W. (Los Alamos Scientific Lab., NM). *Proc. IEEE (Inst. Electr. Electron. Eng.)*; **63**: No. 8, 1260-1261(Aug 1975).

An electronic identification system which uses modulated backscatter from an RF beam-powered tag is described. A subcarrier is used in the return signal format to allow separation from the background clutter and to allow use of a novel method to avoid RF phase problems.

PARTICLE ACCELERATORS

DESIGN, DEVELOPMENT, AND OPERATION

7165 (BNL—20550(Vol.1), pp 170-181) **Novel mechanisms for particle acceleration.** Willis, W.J. (European Organization for Nuclear Research, Geneva). 1975.

From Proceedings of the ISABELLE summer study; Upton, New York, USA (14 Jul 1975).

In Proceedings of the 1975 ISABELLE summer study. Volume I. Summary reports of working groups.

Intense relativistic electron beams (IREB) and lasers are considered as possible power sources for particle acceleration. IREB collective effect accelerators could lead to multi-GEV acceleration, but a method of controlling the velocity of the beam front, or charge neutralization, is needed. In principle, laser accelerators would work, but the maintenance of mechanical tolerances is difficult. Laser driven collective accelerators are also a possibility. (PMA)

7166 (CONF-741040—P1, pp 1-10) **New heavy-ion accelerator facility at Oak Ridge.** Stelson, P.H. (Oak Ridge National Lab., TN). 1974.

From 3. conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In Proceedings of the third conference on application of small accelerators. Volume I. The use of small accelerators in research and teaching.

Funds were obtained to establish a new national heavy-ion facility to be located at Oak Ridge. The principal component of this facility is a 25-MW tandem designed specifically for good heavy-ion acceleration, which will provide high quality beams of

medium weight ions for nuclear research by itself. The tandem beams will also be injected into ORIC for additional energy gain, so that usable beams for nuclear physics research can be extended to about A = 160. A notable feature of the tandem is that it will be of the "folded" type, in which both the negative and positive accelerating tubes are contained in the same column. The accelerator system, the experimental lay-out, and the time schedule for the project are discussed. (auth)

7167 (CONF-741040—P1, pp 311-321) **Survey of teaching experiments with small accelerators.** Treado, P.A.; Lambert, J.M. (Georgetown Univ., Washington, DC). 1974.

From 3. conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In Proceedings of the third conference on application of small accelerators. Volume I. The use of small accelerators in research and teaching.

Accelerator facilities are being used to provide an educational experience to undergraduate students, both science and nonscience majors, and to graduate students. Nuclear physics, accelerator physics, atomic physics, chemistry, materials science, and some nuclear techniques applied to biology, medicine and energy/environmental problems are components of various courses. Previously published experiments are the ones most frequently used, but societal needs have caused some recent, interesting experiments to be adopted. A brief outline of a number of conventional and interesting experiments, and a tabulation of reference materials pertinent to such experiments is given. Experimental science can be presented to students in a dramatic and an exciting manner with an accelerator and readily available, but quite inexpensive, ancillary equipment. Lectures, discussions, demonstrations, and the collection and analysis of data provide a well-rounded educational experience. (auth)

7168 (CONF-741040—P1, pp 371-373) **International Atomic Energy Agency programme and activity on the utilization of low energy accelerators.** Shalnov, A.V.; Whetstone, S.L. (IAEA, Vienna). 1974.

From 3. conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In Proceedings of the third conference on application of small accelerators. Volume I. The use of small accelerators in research and teaching.

One of the chief missions of the Agency is as intermediary between the more highly developed of its member states and the less developed. This involves transmittal of needs of the latter to the former and, where possible, in response to the needs, an appropriate transfer of information and technical assistance. The physics section of the IAEA has recently encouraged and supported requests for technical assistance for programs based on neutron activation studies or pedagogic neutron physics experiments for institutes entering the nuclear field. Neutron generator laboratories have been set up with IAEA-assistance most recently in Burma, Hong Kong, Lebanon. Other recent technical assistance projects involving low-energy accelerators include: (1) consultation on the future program for the accelerator laboratory in Algeria; (2) equipment and experts to assist the nuclear physics program at the Van de Graaff in Bangladesh; (3) expert assistance and equipment in support of the installation of an electron linear accelerator in Egypt; and (4) expert assistance for nuclear physics studies at the cyclotron in Chile. A large number of young scientists, particularly from S.E. Europe, but also from the Middle East and South America, have received training in nuclear physics experimentation by advanced countries at low energy accelerator laboratories under the IAEA fellowship program. (auth)

7169 (LA—6156-PR) **Medium-energy physics program. Progress report, 1 May—31 July 1975.** Dunn, E. (comp.). (Los Alamos Scientific Lab., N.Mex. (USA)). Nov 1975. Contract W-7405-ENG-36. 65p. Dep. NTIS $5.45.

The continuing development, operation, and research programs of the LAMPF Linac (Clinton P. Anderson Meson Physics Facility) facilities are discussed. Progress on the following activities are reported: (1) engineering support; (2) accelerator support; (3) accelerator systems development; (4) injector systems; (5) electronic instrumentation and computer systems; (6) accelerator operations; (7) experimental areas; (8) large spectrometer systems; (9) research; (10) practical applications; (11) management; and (12) publications. (PMA)

7170 (LA-UR—75-2205) **Clinton P. Anderson Meson Physics Facility and its operational safety program.** Putnam, T.M. (Los Alamos Scientific Lab., N.Mex. (USA)). 1975. Contract W-7405-ENG-36. 6p. (CONF-760202—17). Dep. NTIS $4.50.

From 9. topical symposium on operational health physics; Denver, Colorado, USA (9 Feb 1976).

The Clinton P. Anderson Meson Physics Facility (LAMPF) at the Los Alamos Scientific Laboratory consists of/ (1) a medium-energy, high-intensity linear proton accelerator; (2) experimental areas designed to support a multidisciplined program of research and practical applications; and (3) support facilities for accelerator operations and the experimental program. The high-intensity primary and secondary beams at LAMPF and the varied research program create many interesting and challenging problems for the Health Physics staff. A brief overview of LAMPF is presented, and the Operational Safety Program is discussed, with emphasis on the radiological safety and health physics aspects. (auth)

7171 (LA-UR—75-2235) **Average neutron energy measurement at an accelerator facility, a practical health physics problem.** Miller, A.J. (Los Alamos Scientific Lab., N.Mex. (USA)). 1975. Contract W-7405-ENG-36. 6p. (CONF-760202—12). Dep. NTIS $4.50.

From 9. topical symposium on operational health physics; Denver, Colorado, USA (9 Feb 1976).

Surveys designed to estimate the average energy of neutrons escaping from shielded enclosures were made at the Clinton P. Anderson Meson Physics Facility (LAMPF). Information obtained from these data proved to be of value in establishing response factors for the personnel monitoring dosimeters (NTA film). The value of measuring average neutron energies was demonstrated about one year ago, when the monthly film badge report indicated significant neutron exposures to personnel of an experimental group at LAMPF. Neutron radiation-survey data, as well as recorded data from area monitoring stations, indicated much lower personnel neutron doses. Subsequent average neutron energy measurements, at the location of interest, revealed a well-defined region where average neutron energies were considerably greater than previously measured in other occupied areas of the accelerator facility. A discussion is given the rationale for the decision to alter for these experimenters the NTA film response factors from that normally applied to the LAMPF film badges. (auth)

7172 **Relativistic electron beam device.** Freeman, J.R.; Poukey, J.W.; Shope, S.L.; Yonas, G. (to U.S. Energy Research and Development Administration). US Patent 3,892,970. 1 Jul 1975. Filed date 11 Jun 1974. 8p.

PAT-APPL-478,199.

A design is given for an electron beam device for irradiating spherical hydrogen isotope bearing targets. The accelerator, which includes hollow cathodes facing each other, injects an anode plasma between the cathodes and produces an approximately 10 nanosecond, megajoule pulse between the anode plasma and the cathodes. Targets may be repetitively positioned within the plasma between the cathodes, and accelerator diode arrangement permits materials to survive operation in a fusion power source. (auth)

7173 **All-magnetic extraction for cyclotron beam reacceleration.** Hudson, E.D.; Mallory, M.L. (to U.S. Energy Research and Development Administration). US Patent 3,896,392. 22 Jul 1975. Filed date 21 Feb 1974. 4p.

PAT-APPL-444,458.

An isochronous cyclotron can be modified to provide an initial electron stripping stage, a complete acceleration of the stripped ions through the cyclotron to a first energy state, means for returning the ions to an intermediate cyclotron orbit through a second stripping stage, further acceleration of the now higher energy stripped ions through the cyclotron to their final energy, and final extraction of the ions from the cyclotron. (auth)

BEAM DYNAMICS, FIELD CALCULATIONS, AND ION OPTICS

7174 (CONF-741040—P1, pp 43-57) **Ion optics for accelerators.** Enge, H.A. (Massachusetts Inst. of Tech., Cambridge). 1974.

From 3. conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In Proceedings of the third conference on application of small accelerators. Volume I. The use of small accelerators in research and teaching.

A review is given of ion-optic devices used in particle accelerators, including electrostatic lenses, magnetic quadrupoles, and deflecting magnets. Tube focusing in dc accelerators is also treated, and a novel scheme for shaping the electrodes to produce strong focusing is described. The concepts of emittance (phase space) and emittance conservation are briefly discussed. Chromatic and spatial aberrations are introduced, and it is shown how they can be calculated and sometimes substantially reduced. Some examples are given. (auth)

AUXILIARIES AND COMPONENTS

7175 (ORNL-tr—4064) **Polar profile of 52° sectors.** Bibet, D.; Ohayon, M. 29 Oct 1975. Translated by Martha Gerrard from report No. GANIL 75-38. 26p. Dep. NTIS $5.00.

A study was made of the polar profile of the 52° sector magnet faces for the GANIL heavy ion accelerator project, which was authorized in September, 1975. An attempt was made to find a profile satisfying several conditions, including: (1) the magnetic angle of the magnet should vary as little as possible for all induction levels; (2) the magnetic and geometric angles of the sector should be equal; (3) the profile should allow for the space occupied by and the environment of the hf cavity; and (4) best use should be made of the space available for trim coil connections. Results of a two dimensional approximation using a computer program are presented. (PMA)

7176 **A ring lens for focusing ion beams to uniform densities.** Johnson, C.H. (Oak Ridge National Lab., Tenn. (USA)). *Nucl. Instrum. Methods;* **127**: No. 2, 163-171(1 Aug 1975).

An electrostatic lens was designed and built to focus a beam of positive ions into uniform density on a target. The lens has two concentric field regions with a grid separating the inner zero field from the outer radial field. For proper operation, the incident ions must emanate with axial symmetry and Gaussian or similar divergence from a small source. An appendix is included on the symmetrization of elliptical beams by a quadrupole singlet lens. (NL)

7177 (ORNL-tr—4065) **General study of trim coils of magnets in GANIL sectors.** Riche, J. 3 Oct 1975. Translated by Martha Gerrard from GANIL 75-41. 21p. Dep. NTIS 4.50.

To obtain isochronism in the machine, an attempt was made to follow a B(r) law given by superposing on the basic field, in principle homogeneous, defined by the excitation coils and the poles, a corrector field formed by a system of correction coils arranged on the surface of the poles. The number of corrector conductors is limited by space considerations, cost, and the need to have separate feeds. (auth)

ION SOURCES

7178 (CONF-741040—P1, pp 11-30) **Ion sources for accelerators.** Alton, G.D. (Oak Ridge National Lab., TN). 1974.

From 3. conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In Proceedings of the third conference on application of small accelerators. Volume I. The use of small accelerators in research and teaching.

A limited review of low charge sate positive and negative ion sources suitable for accelerator use is given. A brief discussion is also given of the concepts underlying the formation and extraction of ion beams. Particular emphasis is placed on the technology of ion sources which use solid elemental or molecular compounds to produce vapor for the ionization process. (auth)

7179 **Means for obtaining a metal ion beam from a heavy-ion cyclotron source.** Hudson, E.D.; Mallory, M.L. (to U.S. Energy Research and Development Administration). US Patent 3,898,496. 5 Aug 1975. Filed date 12 Aug 1974. 4p.

PAT-APPL-497,176.

A description is given of a modification to a cyclotron ion source used in producing a high intensity metal ion beam. A small amount of an inert support gas maintains the usual plasma arc, except that it is necessary for the support gas to have a heavy mass, e.g., xenon or krypton as opposed to neon. A plate, fabricated from the metal (or anything that can be sputtered) to be ionized, is mounted on the back wall of the ion source arc chamber and is bombarded by returning energetic low-charged gas ions that fail to cross the initial accelerating gap between the ion source and the accelerating electrode. Some of the atoms that are dislodged from the plate by the returning gas ions become ionized and are extracted as a useful beam of heavy ions. (auth)

INJECTION AND EXTRACTION SYSTEMS

7180 (JINR—P9-9139) **System for capturing injected electrons without energy change.** Gabanets, I.; Gurach, Kh.; Zhabitskii, V.M.; Ivanov, I.N.; Mironov, V.I.; Rashevskii, V.P.; Sergeev, A.P.; Stetsenko, S.G.; Tyutyunnikov, S.I.; Fartushnyi, V.P. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 20p. (In Russian). Dep. NTIS (US Sales Only) $4.50.

An injection system was examined in which the magnetic field, rapidly changing at the moment of injection, is created by two pairs of coils with currents in opposite directions. The average field in such a system is significantly less than the field on the orbit, and, therefore, in the injection process, the energy of the electrons is practically unchanged. The dimensions of the beam are determined by the amplitude oscillations of the latest captured particles, which makes the system preferable for the injection of dense short bunches. (JSR)

EXPERIMENTAL FACILITIES AND EQUIPMENT

7181 (CONF-741040—P1, pp 31-42) **Accelerator and neutron targets: a survey.** Kobisk, E.H. (Oak Ridge National Lab., TN). 1974.

From 3. conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In Proceedings of the third conference on application of small accelerators. Volume I. The use of small accelerators in research and teaching.

Although advances in electronics, ion source physics, detector technology, and other technical aspects of accelerator science have resulted in the capability of making highly sophisticated and accurate measurements of nuclear and atomic properties, the significance of such measurements is frequently dictated by the form, composition, and other characteristics of the target containing the nuclear species being studied. Consideration must be given to the impurity content, number of isotope nuclei per unit area, uniformity of nuclei distribution in the target, physical strength of the target, and myriad other factors. Most target characteristics are related to the mode(s) of preparation and to the quality of isotopic material used. A wide variety of target types and associated preparative methods are described and evaluated, together with methods of target characterization. (auth)

7182 (CONF-741040—P1, pp 58-63) **Recent trends in particle accelerator radiation safety.** Ohnesorge, W.F.; Butler, H.M. (Oak Ridge National Lab., TN). 1974.

From 3. conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In Proceedings of the third conference on application of small accelerators. Volume I. The use of small accelerators in research and teaching.

The use of particle accelerators in applied and research activities continues to expand, bringing new machines with higher energy and current capabilities which create radiation safety problems not commonly encountered before. An overview is given of these increased ionizing radiation hazards, along with a discussion of some of the new techniques required in evaluating and controlling them. A computer search of the literature provided a relatively comprehensive list of publications describing accelerator radiation safety problems and related subjects. (auth)

7183 (CONF-741040—P1, pp 64-77) **Practical and research aspects of beam-foil spectroscopy.** Bashkin, S. (Univ. of Arizona, Tucson). 1974.

From 3. conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In Proceedings of the third conference on application of small accelerators. Volume I. The use of small accelerators in research and teaching.

Practical aspects of the application of low-energy accelerators to research in beam-foil spectroscopy are discussed, and the kinds of equipment and associated costs are described in some detail. Some typical beam-foil experiments, emphasizing the most recent studies, are treated so as to show how relatively simple facilities can be used to produce physics of great interest. (auth)

7184 (LA-UR—75-2181) **Software system for data acquistion in nuclear physics experiments using CAMAC.** Minor, M.M.; Shlaer, S.; Thomas, R.F. Jr. (Los Alamos Scientific Lab., N.Mex. (USA)). 1975. Contract W-7405-ENG-36. 7p. (CONF-751116—19). Dep. NTIS $3.50.

From Nuclear science symposium; San Francisco, California, USA (17 Nov 1975).

An event-oriented, modular software system for data acquisition in nuclear physics experiments was implemented on PDP-11 computers under the RSX-11D operating system. The system is designed to support high-speed data acquisition in a broad variety of nuclear physics experiments having multiple event types and using CAMAC instrumentation as the experimental interface. The system provides a simple, problem-oriented language for the specification of CAMAC operations to acquire data from each class of event. It provides automatic buffering of experimental data from the CAMAC hardware and recording on magnetic tape. Certain common utility functions are provided, especially histogram entries and plotting on on-line displays, along with associated operator control functions. The experimenter specializes the system to his needs by writing FORTRAN subroutines which specify necessary on-line analysis of data and control histogram entry. The software depends on a special event-trigger module which was designed in conjunction with the software and is used to

identify the various different classes of events, to facilitate manual control and testing of an experiment, and to facilitate communication between different software modules in the system. (3 figures) (auth)

7185 (LBL—4000, pp 377-378) **Extraction of $^{20}Na^{+}$ ions from a He jet ion source.** Gough, R.A.; Littlejohn, D.; Vieira, D.J.; Cerny, J. Jul 1975.

In Nuclear chemistry. Annual report, 1974.

STORAGE RINGS

7186 (BNL—20550(Vol.1)) **Proceedings of the 1975 ISABELLE summer study, July 14—25, 1975. Volume I. Summary reports of working groups.** (Brookhaven National Lab., Upton, N.Y. (USA)). 1975. 195p. (CONF-750737—P1). Dep. NTIS $8.50.

From Proceedings of the ISABELLE summer study; Upton, New York, USA (14 Jul 1975).

Results are presented of a project to improve, reinforce, or modify the concepts contained in the proposal for the ISABELLE storage rings. Summaries from the working groups are given, and the following topics are discussed: (1) initial and low-luminosity experiments; (2) design of a lepton detector; (3) large equipment and facilities; (4) experimental insertions; (5) new experimental ideas; (6) the accelerator lattice; (7) beam transfer, injection, and ejection; (8) beam stacking and acceleration; (9) performance limitations; (10) magnets and cryogenics; (11) radiation effects; (12) the vacuum system; (13) computer control and monitoring; (14) beam production options; and (15) novel acceleration schemes (for future accelerators). A separate abstract was prepared for each of the fifteen presentations for ERDA Research Abstracts (ERA) and for Nuclear Science Abstracts (NSA). (PMA)

7187 (BNL—20550(Vol.1), pp 1-8) **Initial and low-luminosity experiments.** Good, M.L. (State Univ. of New York, Stony Brook). 1975.

From Proceedings of the ISABELLE summer study; Upton, New York, USA (14 Jul 1975).

In Proceedings of the 1975 ISABELLE summer study. Volume I. Summary reports of working groups.

A study was made of possible experiments in hadron physics, and the results are summarized. All of the experiments examined were, as it turned out, capable of being performed on the planned ISABELLE storage rings without machine modifications. The areas of fundamental interest were: (1) total cross section studies; (2) multiplicity distributions and short range correlation studies; (3) elastic scattering; and (4) single particle spectra. (PMA)

7188 (BNL—20550(Vol.1), pp 9-51) **Design of a lepton detector for ISABELLE.** Burnstein, R. (Illinois Inst. of Tech., Chicago); Carithers, W.C.; Duong-van, M. 1975.

From Proceedings of the ISABELLE summer study; Upton, New York, USA (14 Jul 1975).

In Proceedings of the 1975 ISABELLE summer study. Volume I. Summary reports of working groups.

The theoretical background is given for a proposed experiment to detect W mesons using their leptonic decay mode. A lepton detector was designed for use at the planned ISABELLE proton—proton colliding beam storage rings. The general configuration of the detector is shown, and an electron identification module, an electron-hadron calorimeter, methods of muon identification, and an optional central detector (magnetic solenoid spectrometer) are discussed. (PMA)

7189 (BNL—20550(Vol.1), pp 52-69) **Large equipment and facilities.** Rosenson, L. (Massachusetts Inst. of Tech., Cambridge); Ting, S.; Russell, J. 1975.

From Proceedings of the ISABELLE summer study; Upton, New York, USA (14 Jul 1975).

In Proceedings of the 1975 ISABELLE summer study. Volume I. Summary reports of working groups.

A general purpose modular multiparticle spectrometer for studying hadronic interactions was considered for the planned ISABELLE storage rings. Spectrometer systems considered had to meet several criteria, i.e., their net effect on the beams was to be made negligible; and their solid angle coverage, resolutions, and particle identification characteristics were to be optimized with respect to available space, machine constraints, and cost. The spectrometer configuration, associated detectors and their cost, magnets, and their cost, vacuum chamber requirements, and the solenoidal magnet are discussed. (PMA)

7190 (BNL—20550(Vol.1), pp 70-83) **Experimental insertions.** Sandweiss, J. (Yale Univ., New Haven); Kycia, T.F. 1975.

From Proceedings of the ISABELLE summer study; Upton, New York, USA (14 Jul 1975).

In Proceedings of the 1975 ISABELLE summer study. Volume I. Summary reports of working groups.

A discussion is given of the eight identical experimental insertions for the planned ISABELLE storage rings. Four sets of quadrupole doublets are used to match the β functions in the insertions to the values in the cells, and the total free space available at the crossing point is 40 meters. An asymmetric beam energy operation is planned, which will be useful in a number of experiments. (PMA)

7191 (BNL—20550(Vol.1), pp 84-110) **New and unthinkable ideas in high energy physics.** Lederman, L.M. (Columbia Univ., New York). 1975.

From Proceedings of the ISABELLE summer study; Upton, New York, USA (14 Jul 1975).

In Proceedings of the 1975 ISABELLE summer study. Volume I. Summary reports of working groups.

Possible future high energy physics experiments and the required detectors are discussed for colliding proton beams in storage rings. Analyses are given on the topics of: (1) baryon conservation; (2) a new object detector; (3) the search for heavy leptons at ISABELLE; (4) identifying super-massive particles decaying solely into very many hadrons; (5) production of anti-nuclei at ISABELLE; and (6) a metastable neutral particle arm. (PMA)

7192 (BNL—20550(Vol.1), pp 111-116) **ISABELLE lattice.** Smith, L. (Univ. of California, Berkeley). 1975.

From Proceedings of the ISABELLE summer study; Upton, New York, USA (14 Jul 1975).

In Proceedings of the 1975 ISABELLE summer study. Volume I. Summary reports of working groups.

An analysis is given of a number of variants of the basic lattice of the planned ISABELLE storage rings. The variants were formed by removing cells from the normal part of the lattice and juggling the lengths of magnets, cells, and insertions in order to maintain a rational relation of circumference to that of the AGS and approximately the same dispersion. Special insertions, correction windings, and the working line with nonlinear resonances are discussed. (PMA)

7193 (BNL—20550(Vol.1), pp 117-125) **Beam transfer, injection, and ejection at ISABELLE.** Teng, L.C. (Fermi National Accelerator Lab., Batavia, IL); van Steenbergen, A. 1975.

From Proceedings of the ISABELLE summer study; Upton, New York, USA (14 Jul 1975).

In Proceedings of the 1975 ISABELLE summer study. Volume I. Summary reports of working groups.

Although the design of the injection and the ejection-beaming dump systems for the planned ISABELLE storage rings is essentially complete, some efforts were made to review design details. The design was found to be sound and workable, and no obvious improvements were discovered. Several preliminary conclusions were drawn: (1) the impedance sum of the injection, ejection, and beam scraper components is expected to be less than 1 ohm; (2) all normal operation particle losses can be absorbed safely in the scraper-absorber systems as conceptually designed; (3) a fast accidental beam dump on the internal absorber at 30 GeV will not damage the absorber or drive the superconducting structure normal; and (4) a fast internal beam dump at 200 GeV would not drive the superconducting structure normal, but the beam absorber would suffer local damage. (PMA)

7194 (BNL—20550(Vol.1), pp 126-132) **Stacking and acceleration at ISABELLE.** Schnell, W. (European Organization for Nuclear Research, Geneva). 1975.

From Proceedings of the ISABELLE summer study; Upton, New York, USA (14 Jul 1975).

In Proceedings of the 1975 ISABELLE summer study. Volume I. Summary reports of working groups.

Beam transfer from the AGS and beam stacking in the planned ISABELLE storage rings are discussed, and a method for avoiding unnecessary dilution of the stacked beam is presented. Coupled longitudinal oscillations, instability inside a beam bunch at high inside-bunch mode numbers, and the possibility of rebunching and accelerating the stacked beam by a separate rf system are also discussed. (PMA)

7195 (BNL—20550(Vol.1), pp 133-139) **Performance limitations at ISABELLE.** Keil, E. (European Organization for Nuclear Research, Geneva). 1975.

From Proceedings of the ISABELLE summer study; Upton, New York, USA (14 Jul 1975).

In Proceedings of the 1975 ISABELLE summer study. Volume I. Summary reports of working groups.

The transverse stability of coasting beams in the planned ISABELLE storage rings was studied. The beam—beam tune shift limitation at 0.005 can be avoided, and a computer simulation seems to show 0.005 is a pessimistic limit. For beams of reasonable smoothness on the edge, the actual limit should be somewhat higher. Some coupling effects due to the beam—beam interaction are also examined. (PMA)

7196 (BNL—20550(Vol.1), pp 140-148) **Magnet and cryogenics for ISABELLE.** Thomas, D.B. (Rutherford High Energy Lab., Chilton, Eng.). 1975.

From Proceedings of the ISABELLE summer study; Upton, New York, USA (14 Jul 1975).

In Proceedings of the 1975 ISABELLE summer study. Volume I. Summary reports of working groups.

A critical review was made of the present status and future plans of the Brookhaven National Laboratory superconducting magnet program with respect to the planned ISABELLE storage rings. Recommendations are made on possible technical improvements, the future development program, and areas where cost reduction should be sought. (PMA)

7197 (BNL—20550(Vol.1), pp 149-150) **Radiation effects at ISABELLE.** Sanger, P.A. (Fermi National Accelerator Lab., Batavia, IL); Danby, G.T. 1975.

From Proceedings of the ISABELLE summer study; Upton, New York, USA (14 Jul 1975).

In Proceedings of the 1975 ISABELLE summer study. Volume I. Summary reports of working groups.

Shielding, radiation damage, and radiation heating at the planned ISABELLE storage rings were considered. Radiation shielding studies were reviewed and were found to be adequate for present day dosage limits. Radiation damage could be encountered in some extreme cases, but is not expected to limit the performance of the superconducting magnets. Experiments to study the effect of radiation heating on actual magnets are recommended. (PMA)

7198 (BNL—20550(Vol.1), pp 151-159) **Vacuum system for ISABELLE.** Hobson, J.P. (National Research Council of Canada, Ottawa). 1975.

From Proceedings of the ISABELLE summer study; Upton, New York, USA (14 Jul 1975).

In Proceedings of the 1975 ISABELLE summer study. Volume I. Summary reports of working groups.

An analysis is presented of the proposed vacuum system for the planned ISABELLE storage rings with respect to acceptability and practicality from the vacuum viewport. A comparison is made between the proposed vacuum system and the vacuum system at the CERN ISR, and some comments on various design and operational parameters are made. (PMA)

7199 (BNL—20550(Vol.1), pp 160-162) **Computer control and monitoring of ISABELLE.** Mallory, K.B. (Stanford Linear Accelerator Lab., CA). 1975.

From Proceedings of the ISABELLE summer study; Upton, New York, USA (14 Jul 1975).

In Proceedings of the 1975 ISABELLE summer study. Volume I. Summary reports of working groups.

The operational requirements of the computer control system for the planned ISABELLE storage rings are discussed. The system should consist of a large number of rather specialized computers, of one or at most two types, and should all use the same structure for programming, data management, and linking. (PMA)

7200 (BNL—20550(Vol.1), pp 163-169) **Options at ISABELLE.** Tigner, M. (Cornell Univ., Ithaca, NY). 1975.

From Proceedings of the ISABELLE summer study; Upton, New York, USA (14 Jul 1975).

In Proceedings of the 1975 ISABELLE summer study. Volume I. Summary reports of working groups.

The options available for producing proton-antiproton and proton-electron colliding beams at the planned ISABELLE storage rings were examined. A search was made for weak points in the options as proposed, and an effort was made to determine ways to improve the presently conceived designs. The methods proposed were found to be basically sound and can be expected to perform at levels given in the proposal. Some directions for further investigation are discussed involving phase space reduction of the beams, longitudinal polarization of electrons, and background problems. (PMA)

7201 (LBL—4433) **Strong turbulence and the anomalous length of stored particle beams.** Channell, P.J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1975. Contract W-7405-ENG-48. 102p. Dep. NTIS $6.50.

Thesis.

A theoretical analysis is made of the longitudinal stability of intense beams of charged particles in high energy storage rings. The effect of externally applied radiofrequency fields, i.e., synchrotron oscillations, is included. For electron and positron beams, the damping and quantum excitation due to particle radiation are also included. A criterion for the stability of small longitudinal plasma oscillations is derived and used to obtain the stable size of intense stored beams of electrons and positrons. (auth)

INSTRUMENTATION

RADIATION INSTRUMENTATION

GENERAL DETECTORS AND MONITORS

7202 (BNL—20628) **New approach to timing: the fast—fast system.** Hardy, W.H. II; Lynn, K.G. (Brookhaven National Lab., Upton, N.Y. (USA)). 1975. 5p. (CONF-751116—16). Dep. NTIS $4.50.

From Nuclear science symposium; San Francisco, California, USA (17 Nov 1975).

A dual channel constant fraction timing discriminator incorporating multiple energy windows and coincidence logic has been developed. Incorporation of energy discrimination and fast coincidence logic into the timing channel has distinct advantages in terms of system simplicity, stability and data rates. A prototype applying the F^2 approach has been constructed and tested. The system gives a ^{60}Co FWHM of approximately 210 psec at a singles rate of greater than 7.5×10^5 sec^{-1} (approximately 1200 coincidences/sec). (auth)

7203 (BNWL-MA—62(Pt.2)) **Portable radiation survey instrument manual.** Fleming, D.M. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 21 Aug 1973. 104p. Dep. NTIS $5.50.

The External Dose Evaluation Manual, BNWL-MA-6Z, is being issued by sections as individual procedures are completed to describe the portable radiation survey instruments in use on the Hanford site. The manual is in two parts. Part 1 covers general administrative and technical procedures associated with instrument procurement, radiological standards functions, criticality and high level exposure analysis, and special dosimetry capabilities. The specifications, calibration, operation, performance, and uses of the CP and extended CP (XCP) ionization chambers; the Juno dose ratemeter; the portable count rate meters EGM and PAM; the SNOOPY neutron dose rate meter; the Cutie Pie—Totem Pole meters LPC, TPC, and HPC; the Radeco Portable Alpha Monitor (PAM), and the Low Level Monitor (LLM) are presented. (WHK)

7204 (CEA-R—4704) **Position encoder.** Goursky, V. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Services d'Electronique). Nov 1975. 34p. (In French). Dep. NTIS (US Sales Only) $4.25.

This paper describes circuitry for deriving the quotient of signals delivered by position-sensitive detectors. Digital output is obtained in the form of 10 to 12 bit words. Impact position may be determined with 0.25 percent accuracy when the dynamic range of the energy signal is less than $^1/_{10}$, and 0.5 percent accuracy when the dynamic range is $^1/_{20}$. The division requires an average time of 5 μs for 10-bit words. (auth)

7205 (CONF-741040—P1, pp 365-370) **Neutron standards at the National Bureau of Standards.** Meier, M.M. (National Bureau of Standards, Washington, DC). 1974.

From 3. conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In Proceedings of the third conference on application of small accelerators. Volume I. The use of small accelerators in research and teaching.

The neutron standards program at NBS is discussed with emphasis on Van de Graaff contributions to the overall program. In particular, the characteristics of an associated particle apparatus, which serves as a primary standard for flux normalization at the three percent accuracy level are presented. The "black" detector, a secondary standard suitable as a flux monitor for linac applications and for dosimetry, is characterized, and its calibration with the associated particle technique is described. Future goals of the program are outlined, and the role of the Van de Graaff/associated particle system in achieving the goals is discussed. (auth)

7206 (CONF-751148—1) **249cm^3 Ge(Li) detector for medical imaging.** Kirby, J.A.; Phelps, P.L.; Sawyer, D.; Armantrout, G.A.; Shipley, W.W.; Atkins, F.B.; Charleston, D.B.; Beck, R.N.

(Franklin McLean Memorial Research Inst., Chicago, Ill. (USA); California Univ., Livermore (USA). Lawrence Livermore Lab.). 1975. 4p. Dep. NTIS $4.50.

From Winter meeting of the American Medical Society; San Francisco, California, USA (16 Nov 1975).

The feasibility of constructing a radioisotope scanner using a Ge(Li) detector with adequate efficiency for clinical use is discussed. (WHK)

7207 (LA—6121-MS) **Shift register neutron coincidence module.** Stephens, M.M.; Swansen, J.E.; East, L.V. (Los Alamos Scientific Lab., N.Mex. (USA)). Nov 1975. Contract W-7405-ENG-36. 8p. Dep. NTIS $4.50.

A neutron coincidence module was designed using multistage shift registers to produce the coincidence gates and a crystal controlled oscillator with variable clock outputs to change the gate lengths. The advantage of this system over the conventional, thermal-neutron coincidence gates is a decrease in deadtime by more than an order of magnitude. (auth)

7208 (LA-UR—75-2084) **Two-dimensional nonredundant arrays for coded aperture imaging.** Han, K.S.; Berzins, G.J. (Los Alamos Scientific Lab., N.Mex. (USA)). 1975. Contract W-7405-ENG-36. 11p. (CONF-751141—1). Dep. NTIS $4.50.

From Meeting on fuel and clad motion diagnostics in LMFBR safety test facilities; Albuquerque, New Mexico, USA (11 Nov 1975).

The use of nonredundant pinhole arrays (NRPA) for imaging of radiation sources is discussed. The processes involved in recording and reconstructing coded aperture images are described. (DG)

7209 (LA-UR—75-2232) **Americal National Standard critical accident alarm system.** Smith, D.R. (Los Alamos Scientific Lab., N.Mex. (USA)). 1975. Contract W-7405-ENG-36. 3p. (CONF-760202—10). Dep. NTIS $4.50.

From 9. topical symposium on operational health physics; Denver, Colorado, USA (9 Feb 1976).

An American National Standard has been developed to provide guidance for the design, maintenance, and use of criticality accident alarm systems. Discussion includes several details of this Standard, N16.2-1969, and of a revised version which is now nearing certification. (auth)

7210 (ORNL-TM—5083) **Position-sensitive proportional counters using resistance-capacitance position encoding.** Kopp, M.K.; Borkowski, C.J. (Oak Ridge National Lab., Tenn. (USA)). Dec 1975. Contract W-7405-eng-26. 72p. Dep. NTIS $6.00.

A new method was developed for encoding the position of individual photons, neutrons, or charged particles in proportional counters by using the distributed RC line characteristics of these counters. The signal processing is described and guidelines for the design and operation of these position sensitive proportional counters (PSPCs) are given. Using these guidelines, several prototypic PSPCs were constructed to improve the spatial resolution and shorten the signal processing time; for example, the intrinsic spatial uncertainty was reduced to 28 μ fwhm for alpha particles and 100 μ fwhm for low-energy x rays (2 to 6 keV). Also, the signal processing time was reduced to 0.6 μsec without seriously degrading the spatial resolution. These results have opened new fields of application of the RC position encoding method in imaging distributions of photons, charged particles, or neutrons in nuclear medicine, physics, and radiography. (auth)

7211 (UCRL—76937) **High-efficiency multidetector system for tumor scanning.** Kirby, J.A.; Phelps, P.L.; Armantrout, G.A.; Sawyer, D.; Beck, R.N. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 18 Nov 1975. 9p. (CONF-751116—10). Dep. NTIS $4.50.

From Nuclear science symposium; San Francisco, California, USA (17 Nov 1975).

A high-efficiency detector system developed especially for medical imaging has three specially cut Ge(Li) coaxial detectors (total volume 249 cm^3). At 122 keV, the peak efficiency is 93 percent of that of a 7.6 x 7.6 cm NaI (Tl) detector. Degradation of the paralleled energy resolution is avoided and resolution is improved by 35 percent over that of conventional output-summing techniques by gating the detector outputs. In effect this multiplexes them to a single line output. (auth)

7212 (Y—2004) **System for measuring the uranium concentration of liquid effluents from the enriched uranium recovery facility at the Oak Ridge Y-12 Plant.** Gallman, R.A. (Oak Ridge Y-12 Plant, Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 20p. Dep. NTIS $4.00.

A real-time, on-line monitor has been developed which can measure the uranium concentration of enriched uranium liquid effluent. The monitor uses the thorium L x-ray activity from the decay of ^{234}U as the basis for the measurement. A sodium iodide/thallium-activated scintillation crystal, optically coupled to a photomultiplier, is used as the detector. Evaluation results reveal that the limit of error over the uranium concentration calibration range is less than 1 wt ppM, and the lower limit of sensitivity is 0.50 wt ppM. This monitor cannot be used on a recovery facility which contains fission products. The monitor is installed in the Oak Ridge Y-12 Plant enriched uranium recovery facility and has been operating satisfactorily for some time. (auth)

7213 **Position-sensitive radiation detector.** Borkowski, C.J.; Kopp, M.K. (to Energy Research and Development Administration). Danish Patent 129,882. 30 Oct 1968. Priority date 3 Nov 1967, United States of America (USA). 12p. (In Danish).

A position-sensitive radiation detector is provided by inserting a very high resistance collector in an otherwise conventional detector. The rise time of any pulse therefrom is thereby position-sensitive, but energy independent. The rise time, and therefore the position, is accurately determined by pulse shaping and timing means. (DE)

7214 **Electron multiplier-ion detector system.** Dietz, L.A. (to U.S. Energy Research and Development Administration). US Patent 3,898,456. 5 Aug 1975. Filed date 25 Jul 1974. 4p.

PAT-APPL-491,988.

This patent relates to an improved ion detector for use in mass spectrometers for pulse counting signal ions which may have a positive or a negative charge. The invention combines a novel electron multiplier with a scintillator type of ion detector. It is a high vacuum, high voltage device intended for use in ion microprobe mass spectrometers. (auth)

RADIATION DOSEMETERS

7215 (AEEW-R—1018) **Some notes and comments on the Harshaw 2271 automatic TLD system for personnel dosimetry.** Preston, H.E.; Gill, D.W. (UKAEA Reactor Group, Winfrith. Atomic Energy Establishment). 1975. 17p. Dep. NTIS $4.25.

If the standard UKAEA/RPS film is to be replaced by a different type of dosimeter, it seems obvious at the present time that this replacement will be some form of thermoluminescent device. A commercially available dosimeter and automatic reader is produced by the Harshaw Chemical Company, employing LiF/T.L.D. ribbons. Experience over a period of four weeks with this system is described, with comments on its application to personnel dosimetry. (auth)

7216 (CONF-750331—2) **Precise method for measuring the neutron response of a neutron-insensitive dosimeter.** Kuchnir, F.T.; Vyborny, C.J.; Skaggs, L.S. (Franklin McLean Memorial Research Inst., Chicago, Ill. (USA)). 1975. 8p. (SM—193/51). Dep. NTIS $3.50.

From International symposium on advances in biomedical dosimetry; Vienna, Austria (10 Mar 1975).

By using a newly developed procedure for experimental determination of the neutron sensitivity function of a dosimeter, results were obtained for a commercially available graphite ionization chamber. The n/γ sensitivity as a function of neutron energy from 1 to 20 MeV is presented for the air-filled chamber as well as for continuously flowing CO_2, O_2, and argon. Similar results obtained for homogeneous tissue-equivalent chambers are presented for comparison. A detailed discussion of uncertainties in the final results is presented. (auth)

7217 (CONF-760202—7) **Experiences in environmental monitoring with BeO ceramic dosimeters.** Gammage, R.B.; Haywood, F.F. (Oak Ridge National Lab., Tenn. (USA)). 1975. 7p. Dep. NTIS $4.50.

From 9. topical symposium on operational health physics; Denver, Colorado, USA (9 Feb 1976).

Ceramic BeO disks used as radiation detectors have been evaluated in environmental radiation fields by observing the TL and TSEE signals given off after heating the disks. Fluxes of low energy photons cause the values for the two apparent exposure rates to diverge; this provides a measure of the quality of the photon radiation field. The mean of the TL and TSEE derived exposure rates is close to the exposure rate as determined by other means. The TL-TSEE dosimeters perform satisfactorily provided moisture is not allowed to condense onto the BeO and wet its surface when the temperature falls below the dew point. Thin impervious plastic packets or aluminium cans, containing silica gel desiccant, provide adequate protection. (auth)

7218 (UCRL—77198) **Effect of energy dependence on the evaluations of albedo neutron dosimeters.** Hankins, D.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 21 Nov

1975. Contract W-7405-Eng-48. 9p. (CONF-760202—21). Dep. NTIS $4.50.

From 9. topical symposium on operational health physics; Denver, Colorado, USA (9 Feb 1976).

Albedo neutron dosimeters have proven to be effective as a method of measuring the dose from low-energy neutrons that other types of personnel neutron dosimeters do not detect. Many albedo neutron dosimeters have been designed, and some are being used extensively. All albedo neutron dosimeters are energy-dependent, becoming less sensitive as the energy of the neutrons is increased. In this paper the energy dependence and the effect it has on the evaluation of the dose are discussed. Numerous measurements are shown which were made under field conditions at five reactors, two accelerators, a radiochemistry facility, two plutonium facilities, a low-scatter neutron irradiation facility, three storage vaults, and at the N.B.S. low-energy neutron beams. These measurements show the limits imposed by the energy dependence on the evaluation of the dose determined by albedo neutron dosimeters. In most cases evaluation of an individual's dose occurring in a single facility can be reasonably accurate, but it must be known in which facility the person was exposed. Procedures using the incident thermal neutron response of TLDs located on top of the dosimeter to correct for the energy dependence are discussed; and errors caused by wearing a dosimeter improperly are evaluated. (auth)

7219 (UCRL—77532) **Comparison of gamma-ray exposure rate measurements at Bikini Atoll.** Gudiksen, P.H.; Crites, T.R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 21 Nov 1975. Contract W-7405-Eng-48. 4p. (CONF-760202—18). Dep. NTIS $4.50.

From 9. topical symposium on operational health physics; Denver, Colorado, USA (9 Feb 1976).

A radiological survey of Bikini and Eneu Islands of the Bikini Atoll was conducted during June 1975 to assess the potential radiation doses that may be received by the returning Bikinians. Bikini Atoll was one of the U.S. nuclear weapons testing sites in the Pacific. An integral part of the survey included measurements of the gamma-ray exposure rates at 1 m above the ground with portable NaI instruments at nearly 2700 locations on the two islands. For comparison purposes, similar measurements were made with a pressurized ion chamber at approximately 200 locations, and with LiF and CaF_2:Dy thermoluminescent dosimeters (TLDs) at 80 locations. The results indicate that the NaI scintillators overresponded because of their nonlinear energy characteristics. The responses of the LiF dosimeters and the pressurized ion chamber agreed to within 13 percent. Attenuation studies with LiF TLDs indicated that roughly 25 percent of the total free air exposure rate at 1 m was due to beta radiation. (auth)

7220 (UCRL-Trans—10972) **Dosimetry of high-energy (12—32 MeV) electron beams with radiophotoluminescent glass.** Tosi, G.; Turchi, L.; Maffi, A. Translated from *Minerva Fisiconucl.*; 13: 135-140(1969). 14p. Dep. NTIS $4.00.

An investigation has been carried out by the authors on the possible use of radiophotoluminescent glass for relative dosimetry of high energy intense electron beams. The betatron accelerated electron beams had energy levels ranging from 12 to 32 MeV. Silver-activated metaphosphate glass has been used in the form of 1 mm dia., 6 mm long rods. The experimental results show that in the above energy interval the glass response, at a fixed dose, is independent of energy and dose rate. When the energy is varied, the response is proportional to the absorbed dose, for doses in the range of from 15 to 20 R to 15,000 R. These results suggest that photoluminescent glass can be used as a microdosimeter for the study of high energy electron irradiation. The limitations of the method are discussed by the authors and the possible sources of error are indicated. Finally, a few suggestions are given on ways to minimize error. (auth)

7221 (EUR—5273d-e-f(Vol.2), pp 879-894) **Experimental determination of the neutron sensitivity function of a dosimeter.** Kuchnir, F.T.; Vyborny, C.J.; Skaggs, L.S. (Univ. of Chicago). Mar 1975.

From 2. symposium on neutron dosimetry in biology and medicine; Neuherberg;Munich, F.R. Germany (30 Sep 1974).

In Proceedings of second symposium on neutron dosimetry in biology and medicine. II.

The bombardment of a thick beryllium target by charged particles produces a neutron field which varies with angle and a gamma component which is isotropic. Differences in detector response at two positions in these fields are due to neutrons alone. Such differences were used along with neutron energy distributions measured by time-of-flight techniques to iteratively unfold the neutron response of a Mg-Ar ionization chamber as a function of neutron energy. (auth)

7222 **Fast-neutron solid-state dosimeter.** Kecker, K.H.; Haywood, F.F.; Perdue, P.T.; Thorngate, J.H. (to U.S. Energy Research and Development Administration). US Patent 3,896,306. 22 Jul 1975. Filed date 20 Jun 1974. 4p.

PAT-APPL-481,262.

This patent relates to an improved fast-neutron solid-state dosimeter that does not require separation of materials before it can be read out, that utilizes materials that do not melt or otherwise degrade at about 300°C readout temperature, that provides a more efficient dosimeter, and that can be reused. The dosimeters are fabricated by intimately mixing a TL material, such as $CaSO_4$:Dy, with a powdered polyphenyl, such as p-sexiphenyl, and hot-pressing the mixture to form pellets, followed by out-gassing in a vacuum furnace at 150°C prior to first use dosimeters. (auth)

7223 **Measuring tritium with exoelectron dosimeters.** Gammage, R.B.; Cheka, J.S. (Oak Ridge National Lab., Tenn. (USA)). *Nucl. Instrum. Methods;* 127: No. 2, 279-284(1 Aug 1975).

Small disks of ceramic BeO, called Thermalox 995, are sensitive detectors of tritium when read for thermally stimulated exoelectron emission (TSEE). An additional reading of the thermoluminescence provides a means for estimating the exposure to tritium in the presence of other penetrating radiations. Weakly contaminated surfaces less than 1 nCi/cm², which are small, curved, or difficult to reach, can be monitored accurately. While the detector sensitivity is sufficient to measure tritium gas or tritiated water vapor at allowable, occupational exposure levels, the sensitivity of this particular detector is insufficient for monitoring members of the public exposed continuously to HTO vapor at the MPC. The TSEE peak location and shape are useful features for identifying an exposure to tritium. Prior to reading, rinsing the detector in alcohol is desirable to prevent spurious electron emissions. (NL)

NUCLEAR SPECTROSCOPIC INSTRUMENTAION

7224 (LBL—4000, pp 380-382) **Modified ^{8}Be identifier.** Wozniak, G.J. (Nuclear Structure Lab., Oxford); Jelley, N.A.; Cerny, J. Jul 1975.

In Nuclear chemistry. Annual report, 1974.

7225 (UCRL—77498) **1024-channel portable gamma-ray spectrometer.** McGibbon, A.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 Nov 1975. Contract W-7405-Eng-48. 11p. (CONF-751210—1). Dep. NTIS $4.50.

From Proceeding of the measurement science; San Luis Obispo, California, USA (5 Dec 1975).

An instrument is described which is designed to determine radioactive isotope spectra in the field under adverse environmental conditions. The instrument is battery-powered, stores and compares multiple spectra, and performs computations upon the resulting displayed graph. (auth)

HIGH ENERGY PHYSICS INSTRUMENTATION

7226 (LBL—4255) **Picosecond optical shutter for particle detection.** Fan, B.; Gee, C.M.; Shapiro, G. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Apr 1975. Contract W-7405-ENG-48. 26p. Dep. NTIS $5.00.

Characteristics of an optical shutter utilizing Kerr effect induced by picosecond laser pulses in carbon disulfide are studied experimentally. The shutter has a gate time of 4.5 to 5 ps full width at half-maximum and a transmission of approximately 15 percent at a wavelength 0.53 μm. Such an ultrafast shutter can be used as an optical signal gate in a sampling detection scheme that has picosecond time-resolution. The picosecond optical detection scheme is envisioned to have applications in experimental high-energy physics such as to time-resolve ultrashort Cherenkov or synchrotron radiation emitted by relativistic particles. Methods of synchronizing a laser-activated Kerr shutter with a particle accelerator or synchrotron are discussed. (auth)

7227 **Transition radiation from high energy particles.** Michelson, L.P. Garden City, NY; Adelphi Univ. (1975). 145p. University Microfilms Order No. 75-15,180.

Thesis (Ph. D.).

The properties of x-ray transition radiation from high-energy particles were investigated. The attractive Lorentz factor dependence of x-ray transition radiation suggests that it might be used for the purpose of particle identification at energies above which conventional Cherenkov detectors are useful. Radiators were constructed of 100 uniformly spaced 1-mil aluminum foils with air gaps ranging from 1 to 170 mils. Measurements were taken with each radiator at primary energies of 6.0, 8.0, and 9.8 GeV. The radiation was detected by using a lithium-drifted germanium detector. A simulation, based on theoretical consideration, of the ex-

perimental data was carried out by using Monte Carlo techniques. The simulation took account of all relevant aspects of the experimental generation and detection processes. Comparison of experimental and theoretical results revealed excellent agreement in the distribution in energy of deposition in the Ge(Li) detector and in total energy deposition for all radiators and primary energies investigated. Total deposition was found to rise to an asymptotic value with foil spacing. The success of the theory should allow the design of transition radiation systems (TRD) optimized to a specific task without having to resort to empirical methods. TRD systems will find application in accelerator and cosmic ray experiments. TRD's are being incorporated in several high-energy physics experiments and these experiments are also discussed. (Diss. Abstr. Int., B)

RADIATION EFFECTS ON INSTRUMENT COMPONENTS, INSTRUMENTS, OR ELECTRONIC SYSTEMS

7228 (PEM—22) **Nuclear EMP: review summaries of PEM notes published through October 1975.** Latorre, V.R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Oct 1975. 16p. Dep. NTIS $4.50.

This Protection Engineering and Management Note presents brief summaries of all the PEM Notes published to date (PEM-1 through PEM-43). The notes are written, edited, or revised and published by the Lawrence Livermore Laboratory in connection with Subtask R99QAXEC091 between the Laboratory and the Defense Nuclear Agency.

7229 (PEM—39) **100-kA direct rive EMP pulser.** Allen, J.E. (GTE Sylvania, Inc., Needham Heights, Mass. (USA). Communication Systems Div.). Jul 1975. 29p. Dep. NTIS $5.00.

A pulser is described which was built to directly drive 100 kA into a Minuteman silo closure seal. The pulser has a 50-kV charge voltage, a 10-nanosecond rise time and a 50 microsecond fall time. Physical features and performance characteristics are described along with a summary of its successful operation in pulsing the silo cover. (auth)

7230 (UCRL—51936) **Absorption of short-pulse electromagnetic energy by a resistively loaded straight wire.** Miller, E.K.; Deadrick, F.J.; Landt, J.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 17 Oct 1975. Contract W-7405-Eng-48. 23p. Dep. NTIS $4.00.

Absorption of short-pulse electromagnetic energy by a resistively loaded straight wire is examined. Energy collected by the wire, load energy, peak load currents, and peak load voltages are found for a wide range of parameters, with particular emphasis on nuclear electromagnetic pulse (EMP) phenomena. A series of time-sequenced plots is used to illustrate pulse propagation on wires when loads and wire ends are encountered. (auth)

MISCELLANEOUS INSTRUMENTS

7231 (BARC—784) **Annual report of Test Equipment and Display Systems Section, Electronics Division, 1973.** (Bhabha Atomic Research Centre, Bombay (India)). 1974. 55p. Dep. NTIS (US Sales Only) $4.50.

This report briefly describes the activities of the Test Equipment and Display Systems Section of the Electronics Division. The activities of TE and DS are confined to the development of (a) test equipment for measurements and calibration of electronic equipment, (b) display systems for industry, hospitals and medical research, (c) instrumentation for bio-electric potential analysis and monitoring, and (d) instruments/systems for industry, research on special request. Developments initiated on request are "Automatic Warning System" for Indian Railways and instrumentation for "On-Line Analysis of the Musical Note's Parameters" for the National Centre for Performing Arts. During 1973 the development of the Automatic Warning System (to enhance the existing vigilance and safety system for train speeds up to 200 kmph) and Action Potential Counter (for deeper probing of the part played by various amplitudes of myoelectric potentials in the process of patient recovery during rehabilitation) have been completed and user's trials initiated. Development of various instruments for musical note analysis and a feasibility study for instrumentation for occupational health has been initiated. (auth)

7232 (BARC—816) **Indium antimonide thin film Gaussmeter sensor.** Dua, A.K.; George, V.C.; Agarwala, R.P. (Bhabha Atomic Research Centre, Bombay (India)). 1975. 13p. Dep. NTIS (US Sales Only) $4.50.

The fabrication and uses of thin film indium antimonide Hall effect gaussmeters are described. (WHK)

7233 (CEA-N—1794) **Digital voltmeter test bench.** Gelard, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Services d'Electronique). Jun 1975. 13p. (In French). INIS.

A test bench intended for the automatic checking of digital voltmeter calibrations is described which seems to be unprecedented. Besides describing the various elements of the bench the many advantages offered by the automation of such measurements are presented. (FR)

7234 (CNLM—5350) **Apparatus for gravimetric determination of the effects of low pressure oxidation.** (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 6 Dec 1963. Contract AT(30-1)-2789. 14p. Dep. NTIS $3.50.

The design and capabilities of an apparatus for measuring small weight changes continuously as a result of oxidation at oxygen pressure down to 10^{-7} torr are described. Undoubtedly, pressure control is a most critical portion of any apparatus of this type. A method is described to control pressure accurately during long test periods. An example test result is also presented. (auth)

7235 (CONF-751225—1) **Effect of the recording system and geometric unsharpness on image quality and patient exposure in mannography.** Haus, A.G.; Doi, K.; Bernstein, J.; Chiles, J.T.; Rossmann, K. (Franklin McLean Memorial Research Inst., Chicago, Ill. (USA)). 1975. 4p. Dep. NTIS $3.50.

From Radiological Society of North America meeting; Chicago, Illinois, United States of America "USA" (Dec 1975).

In mammography, many physical factors have a significant effect on image quality and on patient exposure. The choice of the recording system is especially important because its speed is directly related to patient exposure. In certain cases, other physical factors which may limit image resolution can be optimized with the selection of a recording system of increased speed, and patient exposure can be reduced substantially. In this exhibit, three recording systems are compared in terms of speed and resolution: RP/M direct x-ray film, the Lo-dose system, and a conventional medium-speed screen-film system. The effect of geometric unsharpness is evaluated for the Senographe molybdenum target mammographic unit. Geometric unsharpness is determined by the size and shape of the x-ray tube focal spot in combination with the object-to-recording system distance (denoted as o.r.d.) and focal spot-to-object distance. (WHK)

7236 (CRN-CNPA—75-2) **Temporal response and real time measurements with a 5 GHz photocell-oscilloscope system at low light levels.** Sipp, B.; Miehe, J.A.; Clement, G. (Centre National de la Recherche Scientifique, 67 - Strasbourg (France). Centre de Recherches Nucleaires). 1975. 17p. Dep. NTIS (US Sales Only) $3.50.

Experiments have been carried out to investigate by means of picosecond mode-locked laser pulses the performance of fast vacuum photoelectric cells associated with a high sensitivity and high speed cathode-ray tube provided with a channel plate electron multiplier. With an amplitude sensitivity of 140 mV/cm an overall time response of less than 100 ps has been measured. (auth)

7237 (CRN-CNPA—75-3) **Timing fluctuations in photomultipliers. Application to the detection of low flux light signals.** Miehe, J.A.; Sipp, B. (Centre National de la Recherche Scientifique, 67 - Strasbourg (France). Centre de Recherches Nucleaires). 1975. 27p. (In French). INIS.

The timing properties of photomultipliers used in single photon experiments are reviewed. The main problems encountered in applications to measurement of the shape of fast light pulses and determination of the statistical characteristics of light beams are examined. (FR)

7238 (IEA—40A) **Strain gauges.** Gomes, A.V. (Instituto de Energia Atomica, Sao Paulo (Brazil)). Jan 1975. 43p. (In Portuguese). Dep. NTIS (US Sales Only) $4.00.

Theoretical models for strain gauges of the bridge and potentiometric type are developed. Typical circuits are given. The results of experimental testing of the operation and performance of these two types of strain gauges are reported. (JSR)

7239 (JINR—11-7943) **Operation of the spiral measurer control computer.** Kotov, M.; Ponyatovskij, M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1974. 18p. (In Russian). INIS.

7 refs.; 5 figs.

An organization for exchange of information between an operating electronic computer and the electronic equipment of the

spiral reader is described. Work on the electronic computer is examined with regard to storage of measurement data in a regime of direct entrance into memory in real time. (tr-auth)

7240 (LBL—4000, pp 376) **Digital thermoelectric beam power meter.** Nitschke, J.M. Jul 1975.
In Nuclear chemistry. Annual report, 1974.

7241 (MLM—2274) **Modification of toolmakers' microscope for use in an explosive environment.** Draut, C.F. (Mound Lab., Miamisburg, Ohio (USA)). 30 Dec 1975. Contract E-33-1-GEN-53. 22p. Dep. NTIS $4.00.

A large Leitz Universal Toolmakers' Microscope, Model UWM, was modified for use in an explosive environment defined by the National Electric Code as a rating of Class II, Group G. Use of the explosion-proof (EP) microscope provided a means for dimensionally measuring delicate pressed explosive material without contacting the material and subjecting it to possible contamination and mechanical destruction. Inexpensive design concepts, material, and hardware were used to effect the modifications of explosion-proofing. The accuracy, sensitivity, and repeatability of the Toolmakers' Microscope were not altered by the modification. (auth)

7242 (MLM—2278) **Techniques employed for ultrasonic thickness gauging of TRU plastic drum liners.** Dudley, W.A. (Mound Lab., Miamisburg, Ohio (USA)). 9 Jan 1976. Contract E-33-1-Gen-53. 6p. Dep. NTIS $4.00.

A ratio method and a direct readout method are described for ultrasonic measurement of the wall thickness of plastic drum liners. Although both procedures use the same commercial equipment and give identical results, the direct readout technique is preferred, because it allows an untrained operator to obtain quality results even though a linear change in longitudinal sound velocity as a function of material thickness is occurring. (auth)

7243 (UCRL—50025-75-4, pp 11-13) **Automatic calibration system saves time, improves accuracy.** 8 Oct 1975.
In Electronics Engineering Department quarterly report No. 4, 1975.

It no longer takes days to check out and calibrate the multitude of digital data-gathering instruments at the Nevada Test Site. The EE Department's Field Test Division has installed a new computer-controlled calibration system that does the job much faster, more accurately, and with automatic documentation of results. A description of this system is given. (auth)

7244 (UCRL—50025-75-4, pp 17-19) **Laser pulsetrain used to measure subnanosecond aperture times of pulsed image intensifiers.** 8 Oct 1975.
In Electronics Engineering Department quarterly report No. 4, 1975.

A simple technique for measuring subnanosecond aperture times of pulsed image-intensifier tubes is described. Exact aperture-time information is often needed to diagnose image-intensifier data on fast, transient events. The new method uses the pulsetrain of a modelocked dye laser as the timing source, rather than a single timing pulse, to minimize the jitter and synchronization problems inherent in such fast time measurements. (auth)

7245 (UCRL—50025-75-4, pp 23-25) **EE-developed framing camera adds new dimension to LLL's high-speed-photography capability.** 8 Oct 1975.
In Electronics Engineering Department quarterly report No. 4, 1975.

The EE Department has greatly expanded the Laboratory's high-speed-photography capability by developing a very high-speed image-converter-tube (ICT) framing camera. This sequential, multiframe camera system, the first of its kind, can photograph high-explosive events with greater speed, image resolution, and versatility than ever before possible. It is a selectable-optic system using eight ICTs that can be shuttered simultaneously or separated by preset time delays, all with nanosecond accuracy. Another unique feature is the camera's ability to take "stereo" pictures (coincident photos from different angles), thus adding depth perception to the film record of the event being investigated. (auth)

7246 (UCRL—77558) **Sample management programs for the laboratory automation minicomputer.** Barton, G.W. Jr.; Ames, H.S. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Dec 1975. Contract W-7405-Eng-48. 8p. (CONF-751156—1). Dep. NTIS $4.50.

From 2. OR and D-ADP conference; Gulf Breeze, Florida, USA (11 Nov 1975).

Lawrence Livermore Laboratory was asked to develop and implement functional specifications for the automation of a number of analytical instruments. A brief review of this program and its achievements is presented. (RWR)

7247 (ORNL-tr—4072) **New mass spectrograph.** Mattauch, J.; Herzog, R. Translated by E.G. Silver from *Z. Phys.*; **89**: 786-795(1934). 13p. Dep. NTIS $3.50.

A mass spectrograph is proposed which yields not only directional focusing but also velocity focusing. It consists of a combination of two electro-optical cylindrical lenses (radial electric field and homogeneous magnetic field) which images the ray-delimiting slit on a single location on the photographic plate like an achromatic objective lens even for different radiation velocities. In contrast to this, the Aston mass spectrograph would be equivalent to a set of achromatic prisms which does not yield any sort of image in the optical sense. In addition to the enhancement in sharpness and intensity of the images the arrangement here proposed exhibits a series of additional advantages. (auth)

7248 **Automation trends.** Frazer, J.W. (Univ. of California, Livermore). *Am. Soc. Test. Mater., Spec. Tech. Publ.*; No. 578, 3-10(1975).

There are many forces in the scientific community which are gradually encouraging changes in laboratory automation. These forces and some of the anticipated changes are discussed briefly. The main topic is the new evolving methodology that will be required to effectively implement the computer systems of the future. ASTM Committee E-31's contributions to the development of this methodology is discussed as a prelude to the other papers in the book. (auth)

7249 **Need for automated system specifications and designs.** Frazer, J.W.; Kray, A.M.; Boyle, W.G.; Morris, W.F.; Fisher, E.R. (Univ. of California, Livermore). *Am. Soc. Test. Mater., Spec. Tech. Publ.*; No. 578, 65-76(1975).

The development of system specifications and functional and implementation designs for one chemistry system at the National Environmental Research Center in Cincinnati is discussed. An emission spectrometer for the determination of metals in water samples is studied. Technical details are presented to illustrate the form and context of these three phases of the laboratory automation project. The principles used for this work are the same as those being followed by ASTM Committee E-31 in the development of "guidelines and recommended practices." (auth)

7250 **Scanning electron microscope: subject and servant in teaching.** Hayes, T.L. (Univ. of California, Berkeley). pp 593-600 of In Scanning electron microscopy, 1975. Part III. Chicago; IIT Research Inst. (1975).

From Proceedings of the workshop on teaching of scanning electron microscopy; Chicago, IL, USA (Apr 1975).

Courses dealing with the analytic and experimental aspects of scanning electron microscopy which have been taught at the University of California, Berkeley over the last 10 years are described. (WHK)

7251 **Laser anemometer for large high velocity particles.** Russo, A.J. (Sandia Labs., Albuquerque, NM). *Appl. Opt.*; **14**: No. 1, 18-19(Jan 1975).

The advantages of laser Doppler velocimeters operating in the dual-scatter (two-beam) mode are ease of alignment and use, high SNR, freedom from vibration, and ease of data interpretation. Several disadvantages of the dual scatter mode become apparent, however, if this method is applied to the velocity measurement of large ($\sim$ 100-μm diam) particles. To retain the advantages of high SNR and ease of interpretation for all observation angles, the fringe spacing produced by the crossed beams must be larger than the particle diameter. Since the fringe spacing S is given by $S = \lambda/\sin\theta$, where λ is the laser wavelength and θ is convergence angle, very small convergence angles are required ($\theta < 0.25^{\circ}$). However, as the convergence angle becomes small, the number of fringes in the probe volume decreases, and the individual fringes become broad and diffuse. The probe spot diameter must be made large enough to contain at least two fringes; this results in a reduction in fringe intensity and sometimes in fringe quality. The multiple-beam scatter mode described overcomes some of these problems. The basic idea is to take advantage of the increased sharpness and intensity of the interference fringes in the central Fraunhofer diffraction zone produced by multiple slits (multiple-beam mode) as compared to the interference fringes produced by the two-beam mode. This apparatus has been successfully applied to the problem of measuring particle velocities of up to 1.52 km/sec produced by a gun designed for particle impact tests. (auth)

7252 **Mercury monitor for ambient air.** Hadeishi, T.; Church, D.A.; McLaughlin, R.D.; Zak, B.D.; Nakamura, M.; Chang, B. (Univ. of California, Berkeley). *Science;* **187**: 348-349(31 Jan 1975).

An isotope-shift, Zeeman-effect atomic absorption spectrometer has been demonstrated to have sufficient sensitivity to

continuously monitor the total mercury content of ambient air. At present, the minimum total mercury concentration detectable with this device is 0.2 microgram per cubic meter of air - one fifth of the proposed federal guideline. This is the first technique which responds to both mercury vapor and mercury in particulates available for continuous monitoring at this concentration. (auth)

7253 Plexiglas: a convenient transmission filter for the FIR spectral region. Mon, K.K.; Sievers, A.J. (Cornell Univ., Ithaca, NY). Contract AT(11-1)-3151. *Appl. Opt.*; **14**: No. 5, 1054-1055(May 1975).

It has been demonstrated that disordered solids such as fused quartz or ice I make good transmission filters for the frequency region below 50 cm^{-1}. The strong frequency dependence of the absorption coefficient in these materials makes them superior to the crossed transmission grating and wire reflection meshes commonly used. It is shown that the frequency and temperature dependence of the absorption coefficient of PMMA (Plexiglas) makes it a convenient room or low temperature FIR filter. (WHK)

7254 Restored impulse response of finite-range image deblurring filter. Tichenor, D.A. (Sandia Labs., Livermore, CA); Goodman, J.W. *Appl. Opt.*; **14**: No. 5, 1059-1060(May 1975).

In the absence of noise, a linear spatially invariant blur is completely removed by the application of a transfer function proportional to the inverse of the blur transfer function. However, most blur transfer functions of interest either contain zeros or approach zero; and, consequently, the inverse should cover an infinite dynamic range. In these cases, the inverse can be approximated by a holographic spatial filter that employs a finite range of amplitude transmittance. The effect of finite range on the restored impulse response or point spread function of the combined blurring and deblurring operations are studied. A computer simulation is compared with experimental results for the case of severe defocusing through a circular aperture. (auth)

7255 Non-reduced optimal observers for time-varying linear systems. Watts, A.C. (Sandia Labs., Albuquerque, NM); McDaniel, W.L. *J. Franklin Inst.*; **300**: No. 3, 175-184(Sep 1975).

A method is presented for constructing a nonreduced observer for a finite dimensional linear system. The systems considered are nth order, time-invariant or time-varying forced linear systems which are assumed to be bounded and uniformly completely state reconstructible. The observer dynamics are derived from an optimal estimation formulation which is related to the concept of observability. The cost functional used in this formulation includes a parameter which determines the relative weighting of the system output and the estimate of the initial system state. The result is a practical method of estimating the state of a linear system from noiseless measurements of the input and output. The results are also of theoretical significance in that a direct connection between reconstructibility and the existence of observers is established. (auth)

7256 Derivation of one-dimensional refractive-index profiles from interferograms. McLarnon, F.R.; Muller, R.H.; Tobias, C.W. (Univ. of California, Berkeley). *J. Opt. Soc. Am.*; **65**: No. 9, 1011-1018(Sep 1975).

A method is presented for the derivation of one-dimensional refractive-index fields from interferograms that may be distorted by light-deflection effects. The technique involves an iterative process that employs closed-form solutions for light propagation through inhomogeneous media and a three-parameter polynomial function to describe the refractive-index field. The method was tested by analyzing the interferograms associated with various refractive-index fields generated by diffusion and convection at a solid-fluid interface. The results show that the derived polynomial refractive-index profiles closely approximate the concentration fields and accurately depict the interfacial refractive index. However, the derived interfacial refractive-index gradient can be in error, because of the limitations of the precision with which the exact location of the interface can be established on an experimental interferogram. (auth)

EXPLOSIONS AND EXPLOSIVES

CHEMICAL

7257 (BERC/RI—75/10) **Chemical explosive fracturing tests in the Fort Worth Basin.** Atkinson, C.H. (Energy Research and Development Administration, Bartlesville, Okla. (USA). Bartlesville Energy Research Center). Dec 1975. 135p. Dep. NTIS $6.00.

A field test program was performed to evaluate the effectiveness of chemical explosive detonations in fractures for improving gas productivity from low permeability sandstone formations. Recent development of safe explosives prompted negotiations with explosive service companies and issuance of two contracts each for detonations in three submarginal gas wells. One of these programs is described. Talley-Frac Corp. detonated explosives in three wells operated by Dallas Production, Inc. near Mineral Wells, Texas. A cooperative agreement between Dallas Production, Inc. and ERDA provided for the use of the wells in the stimulation program. Detonations of up to 15,000 pounds of explosive were safely conducted by displacing the explosive down the well casing and into the fractured formation with water pumped from a safe distance. The detonator charge was built into a rubber plug which separated the explosive slurry in the casing from the water which served as a tamp after being used to pump the explosive to bottom. Detonation occurred when the detonator plug reached a retainer set earlier above the perforations and was subjected to a pressure increase. Based on preshot and postshot production performance of the wells, results of the tests showed no production increase in one well and a minor increase in another. One well was lost when the casing was parted by the explosion. A replacement well drilled 50 ft away did not communicate with the zone fractured in the original well. (auth)

7258 (LA—6097-MS) **Detonation of high explosives in Lagrangian hydrodynamic codes using the programmed burn technique.** Berger, M.E. (Los Alamos Scientific Lab., N.Mex. (USA)). Sep 1975. Contract W-7405-ENG-36. 9p. Dep. NTIS $4.50.

Two initiation methods were developed for improving the programmed burn technique for detonation of high explosives in smeared-shock Lagrangian hydrodynamic codes. The methods are verified by comparing the improved programmed burn with existing solutions in one-dimensional plane, converging, and diverging geometries. Deficiencies in the standard programmed burn are described. One of the initiation methods has been determined to be better for inclusion in production hydrodynamic codes. (auth)

7259 (MHSMP—75-5J) **Chemical analysis of TATB. Progress report, October—December 1974.** Faubion, B.D. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). Dec 1974. Contract DA-11-173-AMC-487(A). 10p. Dep. NTIS $3.50.

Progress during October through December 1974 in research on chemical explosives is reported. The kinetics of the base hydrolysis of TATB has been studied as a function of hydroxide concentration and temperature. The initial rate of hydrolysis expressed as $k[OH^-]$ was determined by extrapolation to zero time. The values of the hydrolysis constant k determined at three temperatures were $3.24 \times 10^{-4} hr^{-1}$ (50 C), $2.22 \times 10^{-3} hr^{-1}$ (75 C) and $2.05 \times 10^{-4} hr^{-1}$ (96 C). An activation energy of 15 +- 2 kcal $mole^{-1}$ was calculated from an Arrhenius plot. A method for analysis of the residue chloride in TATB is being developed utilizing base hydrolysis as a means of digesting the TATB and releasing the entrapped chloride. The chloride in the hydrolyzed solution is determined by potentiometric titration with standard silver nitrate using a specific ion electrode. The hydrolysis of 1,3,5-trichloro-2,4,6-trinitrobenzene (TCTNB) containing a small amount of 1,3-dinitro-2,4,6-trichlorobenzene (DNTCB) and 1,3-dinitro-2,4,5,6-tetrachlorobenzene (DNT_4CB) has also been studied to determine the amount of chloride released. (auth)

7260 (MHSMP—75-40) **Liquid chromatographic determination of HMX and RDX in PBX 9404. Progress report, July—September 1975.** MacDougall, C.S.; McGaugh, G.E. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1975. Contract DA-11-173-AMC-487(A). 6p. Dep. NTIS $3.50.

A high speed liquid chromatographic method for determining HMX and RDX in PBX 9404 has been developed. A 300 mg sample of explosive is dissolved in 100 ml acetone, and a 40 µl aliquot of the solution is then injected into an LC system using a 2 m Corasil II column and a 30 percent paradioxane—70 percent cyclohexane carrier at 0.7 ml/min flow rate. The separated HMX and RDX components are measured with a differential UV-detector. The amounts of HMX and RDX are then calculated from measured peak areas. Analyses of standards show recovery of HMX to be 99.7 +- 0.4 percent and RDX is 99.7 +- 0.9 percent recovered. Binder and plasticizer components do not interfere in the analysis. (auth)

7261 (MHSMP—75-40A) **LX-13 processing. Progress report, July—September 1975.** Adams, J.C.; Osborn, A.G.; Stallings, T.L. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1975. Contract DA-11-173-AMC-487(A). 6p. Dep. NTIS $3.50.

Research conducted during July to October 1975 on the processing and performance testing of chemical explosives is reported. Four of the six lots of continuously precipitated PETN

produced last quarter have been formulated into LX-13 and evaluated for firing performance and extrudability. Detonability was improved. Three of the lots fired satisfactorily on the DV blocks; however, extrudability was reduced. Three batches of PETN were formulated this quarter to further examine LX-13 extrudability and detonability. (auth)

7262 (MHSMP—75-40B) **Stability of density in small pressings of LX-14. Progress report, July—September 1975.** Harrell, J.D. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1975. Contract DA-11-173-AMC-487(A). 4p. Dep. NTIS $3.50.

Research conducted during July to October 1975 on compacting of chemical explosives is reported. Bartherm is an ancillary pressing process that can be used to increase and equalize the as-pressed density of PBX parts. The process is relatively new and it was not known if the induced density changes were permanent. Small parts that were processed by the bartherm technique have not experienced a change of density in approximately one and one-half years of observation and the density increase appears to be permanent. (auth)

7263 (MHSMP—75-40H) **TATB performance and sensitivity. Progress report, July—September 1975.** Kramer, P.E. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). Sep 1975. Contract DA-11-173-AMC-487(A). 5p. Dep. NTIS $3.50.

Progress during July to October 1975 in research on chemical explosives is reported. Gap tests conducted on three batches of Teledyne-produced TATB revealed a wide sensitivity range. Impurities are probably responsible for the variation. LLL Blend 6 was tested at three densities to provide a check on the data for LLL Blend 2. Blend 6 was slightly more sensitive than Blend 2. Routine tests of RX-03-BB Blends 6 and 7 revealed nothing unusual. Better results were obtained in the hot (68 C) wedge tests on RX-03-BB but more improvement is needed. (auth)

7264 (MHSMP—75-40J) **Decomposition of HNS in DMF. Progress report, July—September 1975.** Faubion, B.D. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). Sep 1975. Contract DA-11-173-AMC-487(A). 9p. Dep. NTIS $3.50.

Progress during July to October 1975 in research on chemical explosives is reported. Three batches of HNS containing various amounts of DPE and TNB were heated in DMF for seven hours at 100, 120 and 148°C. Samples were withdrawn periodically and the relative percentages of the three constituents were determined by liquid chromatography. At 100 and 120°C the relative percentage of HNS increased with time while the others diminished. At 148°C the opposite was observed. An additional material which has not been identified was also observed in the chromatograms of the materials heated at 148°C. (auth)

7265 (MHSMP—75-40L) **Formulation and process safety. Progress report, July—September 1975.** West, G.T. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1975. Contract DA-11-173-AMC-487(A). 9p. Dep. NTIS $3.50.

Progress during July to October 1975 in research on chemical explosives is reported. Five explosives (HMX, TATB, TCTNB, PETN, and Composition B-3) were subjected to shock tests with a booster system. The explosives were tested dry (except CB-3 and PETN) and wet with typical synthesis/formulation solvents in typical synthesis/formulation concentrations. The four materials tested dry all detonated in 4.4 cm inside diameter by 25.4 cm Plexiglas tubes with 0.635 cm walls. HMX was tested at 90 percent, 67 percent and 25 percent (tested at 10.2 cm diameter by 50.8 cm length) concentrations in water, with detonation observed at only the higher two concentrations. TATB was tested wet with water at 70 percent concentration in both 4.4 and 10.2 cm diameter and failed to detonate in both cases. When tested with toluene at the 75 percent level it also failed to detonate. TCTNB detonated at 79 percent concentration with water, but did not detonate with toluene and water at the 15 percent level. PETN, tested at the 15 and 20 percent levels in acetone and the 20 percent level with water, failed to detonate. The CB-3 test, at 40 percent with Freon TF, detonated. Results of burn tests involving TATB, TCTNB, PETN, HNS and TNT dry and with typical synthesis/formulation solvents and concentrations are included. Generally, those burns involving solvents initially resembled a "normal" organic-fuel fire and eventually the explosive burned. The "dry" burns resembled the later stage of the above fires. There were no explosions. (auth)

7266 (MHSMP—75-40M) **Packing procedure for shipment of PETN pellets. Final report, October 1975.** West, G.T. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1975. Contract DA-11-173-AMC-487(A). 15p. Dep. NTIS $3.50.

Three "detonation tests" and one "burn test" were performed on an AN can, Type AN 8024, containing PETN pellets. Test procedures were discussed with a representative of the Department of Transportation. The can contained all reactions and did not rupture in any of the tests. The packing procedure and container were deemed acceptable for the pellets tested. (auth)

7267 (SAND—75-0314) **New technique for characterizing an explosive for shock initiation sensitivity.** Schwarz, A.C. (Sandia Labs., Albuquerque, N.Mex. (USA)). Dec 1975. Contract AT(29-1)-789. 17p. Dep. NTIS $4.50.

A new technique is described for determining the thin-pulse shock initiation sensitivity of explosives. The test device uses an electrically exploded conductor which in turn propels a thin Kapton flyer-plate into the explosive; the critical energy fluence or "P^2tau" was chosen as the explosive characterization criterion. Seven explosives were rank-ordered by this technique. (auth)

7268 (SC-DR—72-0197) **Containment of explosions in cylindrical shells.** Duffey, T.A.; Mitchell, D.E. (Sandia Labs., Albuquerque, N.Mex. (USA)). May 1972. 29p. Dep. NTIS $4.00.

An experimental and theoretical investigation of the high explosive containment ability of circular cylindrical shells is presented. Approximate expressions for final circumferential strain or radial displacement as a function of cylinder length are developed in terms of elementary functions, based upon an assumed rigid-plastic material relation for the containment vessel. The material relation includes strain hardening and approximate strain rate sensitivity. The expressions are presented in a form convenient for containment design purposes, and are shown to be in reasonable agreement with experimental results for a variety of container materials and radius-to-thickness ratios. (auth)

7269 (TID—26882) **Seismic attenuation studies at the Idaho National Engineering Laboratory.** Navarro, R. (Idaho National Engineering Lab., Idaho Falls (USA)). 1975. Contract AT(10-1)-1502. 73p. Dep. NTIS $5.50.

Five high explosive shots ranging in size from 1,005-16,005 lbs (M/sub L/ of -0.1 to 2.0) were detonated at the Idaho National Engineering Laboratory (INEL) between May 15 and October 17, 1974. These detonations were part of INEL's program, conducted by the United States Geological Survey, to determine the seismic attenuation characteristics in the vicinity of the laboratory. Particle velocity time histories generated by the 5 shots were recorded by L-7 systems deployed at 22 of the 23 temporary locations having a distance range of 0.42-62.9 km from the energy source. In addition, a magnitude (m/sub b/) 6.1 teleseism in the Kuril Islands was recorded at 7 locations. Two important results which have a bearing on the features of the design earthquake response spectra for INEL were obtained: (1) the experimental data suggest that peak particle velocity (and probably acceleration) attenuates more rapidly (i.e., as $R^{-2.18}$ in the vicinity of INEL than in other geographic areas of the United States and (2) the seismic response of sites off-Snake River Plain is significantly greater over a wide range of frequencies than the response of sites on-Snake River Plain. Additional experimental data are needed to improve the precision of these preliminary results. (auth)

7270 (UCRL—51719(Rev.1)) **HSM, a measurements engineering challenge.** Shay, W.M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 8 Dec 1975. Contract W-7405-Eng-48. 95p. Dep. NTIS $5.45.

After one failure and a partial success at instrumenting the aft warhead cases of a hard structure munition (HSM) weapon, we were able to develop instrumentation to record dynamic data in a hostile environment. The environments in which we recorded were the detonation of 100 lb of explosive and the impacting of 15,000 lb of concrete on the instrumented aft warhead case. The case was instrumented primarily with strain gages and accelerometers. Maximum strains were generally less than 10,000 μin./in.; accelerations were generally 100,000 g. An isolated recording system was developed that was immune to external noise sources; transducers were evaluated at anticipated maximum values. Parameters other than aft warhead cases were also measured. (auth)

7271 (UCRL—76887) **Pattern recognition at Lawrence Livermore Laboratory.** Bender, C.F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 23 May 1975. Contract W-7405-Eng-48. 6p. (CONF-750565—1). Dep. NTIS $4.00.

From Pattern recognition workshop; Washington, District of Columbia, USA (1 May 1975).

Possible uses of pattern recognition techniques for solving complex scientific problems are discussed, and previous experience in using the pattern recognition computer code RECOG to solve materials problems, specifically in determining the mechanical properties of high explosives, is described. (LCL)

NUCLEAR

7272 (LA—6154-MS) **Theoretical simulations of the gas explosive simulation technique (GEST) experiments.** Ruppel, H.M.; Norton, J.L. (Los Alamos Scientific Lab., N.Mex. (USA)). Oct 1975. Contract W-7405-ENG-36. 7p. Dep. NTIS $4.50.

To calibrate the ability to predict the dynamic behavior of nuclear fireballs the balloon detonations conducted under DNA sponsorship in November of 1973 have been simulated. These well-instrumented shots provide excellent data to test the reliability of hydrodynamic models for the rise and expansion of very low yield explosions. The results of calculations and conclusions drawn concerning the applicability of such techniques to nuclear fireball simulations are presented. (auth)

7273 (NVO—1163-77) **Project Longshot, final report. Analysis of ground motion and containment, safety program.** (Beers (Roland F.), Inc., Alexandria, Va. (USA)). 6 May 1966. Contract AT(29-2)-1163. 35p. Dep. NTIS $4.00.

Predictions of ground motions and containment were made for the Longshot event. Limits on the areas expected to be within the radius of potential damage (acceleration 0.1 g) and perceptible motion (acceleration 0.001 g) were given. Also, prediction graphs were presented for obtaining peak particle acceleration, displacement and velocity for points of interest on hardrock and unconsolidated material. A preliminary feasibility study was performed to determine the acceptability of the proposed Longshot site from the standpoint of containment and seismic safety. The results of the investigation showed the proposed Longshot event could be successfully executed at the selected location. Subsequently, an exploratory drilling program was performed and a stemming plan was developed. Based upon the findings of the exploratory program and the evaluation of the stemming plan, Beers, Inc. concluded that the event would be contained at the proposed location. Upon detonation, containment was achieved as predicted. No reports of damage or ill-effects due to excessive motions were made. A limited comparison with published ground motion data indicates satisfactory predictions. (auth)

7274 (UCID—16969) **Frictional effects between Overton sand and a simulated casing for a bore hole.** Dong, R.G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 6 Oct 1975. Contract W-7405-Eng-48. 28p. Dep. NTIS $5.00.

A series of tests were run to simulate the frictional effects between Overton sand and the casing for a bore hole for an underground nuclear test. The objective was to find a description for this frictional interaction which can be applied to an analysis of stemming materials under field conditions. (TFD)

7275 (USGS—474-217) **Determination of in situ stress at U12e.18 working point, Rainier Mesa, Nevada test site.** Miller, C.H.; Miller, D.R.; Ellis, W.L.; Ege, J.R. (Geological Survey, Denver, Colo. (USA)). Dec 1975. 24p. Dep. NTIS $4.00.

A three-dimensional determination of stress beyond the influence of tunnel openings was done in U12e.18 drift, Nevada Test Site. The measurements were made with a three-component borehole deformation gage, using an overcoring procedure developed by the U.S. Bureau of Mines. The principal compressive stress magnitudes and directions, as well as compressive and shear stress components along the north-south, east-west, and vertical directions, were calculated from the measurements. The magnitude and orientation of the maximum principal stress are 1,006 pounds per square inch and S. 4° W.; of the intermediate principal stress, 864 pounds per square inch and S. 28° W.; and of the minimum principal stress, 404 pounds per square inch and S. 75° E. Potential planes of fracture caused by rock yielding in tension, which could result from either nuclear detonations or hydraulic fracturing, are estimated from the principal stresses to strike about N. 14° E. and dip about 78° NW. Horizontal stresses were measured that are higher than can be explained from simple gravity loading. (auth)

CIVIL USES

7276 **United States of America.** Fleming, E.H. (Atomic Energy Commission, Washington, DC). pp 23-25 of In Peaceful nuclear explosions. IV. Vienna; International Atomic Energy Agency (1975).

From 4. IAEA panel on peaceful nuclear explosives; Vienna, Austria (20 Jan 1975).

See STI/PUB—414; CONF-750109—.

Developments in US programs for evaluating peaceful uses of nuclear explosions, specifically for shale oil and mineral recovery and for natural gas production stimulation, are briefly described. (LCL)

7277 (LA—6014) **Numerical method for studying the circulation patterns of a fluid in a cavity.** Stephani, L.M.; Butler, T.D. (Los Alamos Scientific Lab., N.Mex. (USA)). Oct 1975. Contract W-7405-ENG-36. 40p. Dep. NTIS $4.00.

The method incorporates three circulation-inducing mechanisms: (1) buoyancy induced by nonuniform initial distribution of heat throughout the fluid, (2) buoyancy induced by removal of heat from the fluid, and (3) forced convection induced by withdrawal of heated fluid and return of cooled fluid. A two-dimensional computer program, CIRCO, based on the Marker-and-Cell (MAC) technique, is used to study the circulation patterns. The report discusses the code and illustrates its capabilities by means of examples from studies conducted for the Pacer project, which investigates the concept of producing electrical power from energy released by thermonuclear explosions in a salt dome. Efficient engineering for withdrawing energy from the cavity requires an understanding of the circulation patterns of the heated fluid. CIRCO provides this information in the form of computer-generated plots. (auth)

7278 (PNE-RB—73) **Project Rio Blanco formation evaluation well (RB-U-4): drilling, completion, and initial testing report.** (Energy Research and Development Administration, Las Vegas, Nev. (USA). Nevada Operations Office). Dec 1975. 60p. (NVO—168). Dep. NTIS $4.50.

Rio Blanco Well RB-U-4 is a gas reservoir evaluation well drilled to a depth of 7,000 feet in the Piceance Basin of northwestern Colorado. This well is a part of Project Rio Blanco whose goal is to demonstrate the potential for commercial development of low-permeability gas reservoirs by nuclear explosive stimulation. Well RB-U-4 was drilled approximately 624 feet from the surface location of the nuclear emplacement well and outside the fractured zone produced by the explosives to obtain information on the undisturbed gas reservoir. The drilling, completion, and initial testing of RB-U-4 including drilling reports, drill bit records, logging records, hole deviation data, casing and cementing descriptions, hydraulic fracturing procedures, flow testing information, and current surface and downhole equipment configuration are described. (auth)

7279 **Project Rio Blanco. Part I. Nuclear operations and chimney re-entry.** Woodruff, W.R.; Guido, R.S. (Univ. of California, Livermore). pp 29-116 of In Peaceful nuclear explosions. IV. Vienna; International Atomic Energy Agency (1975).

From 4. IAEA panel on peaceful nuclear explosives; Vienna, Austria (20 Jan 1975).

See STI/PUB—414; CONF-750109—.

Rio Blanco was the third experiment in the USAEC's Plowshare Program to develop technology to stimulate gas production from geologic formations not conducive to production by conventional means. The project was sponsored by CER Geonuclear Corporation with the Lawrence Livermore Laboratory providing the explosives and several technical programs, such as spall measurement. Three nuclear explosives, specifically designed for this application, were detonated simultaneously in a minimum-diameter emplacement well using many commercially available components of established reliability. The explosive system performed properly under extreme temperature and pressure conditions. Emplacement and stemming operations were designed with the aim of simplifying both the emplacement and reentry, and fully containing the detonation products. An integrated command and control system was used with communication to all three explosives through a single coaxial cable. Reentry and the initial production testing have been completed. To date 98 million cubic feet at STP (2.78 x 10^6 m^3 (STP)) of chimney gas has been produced. (auth)

7280 **Project Rio Blanco. Part II. Production test data and preliminary analysis of top chimney/cavity.** Toman, J. (Univ. of California, Livermore). pp 117-140 of In Peaceful nuclear explosions. IV. Vienna; International Atomic Energy Agency (1975).

From 4. IAEA panel on peaceful nuclear explosives; Vienna, Austria (20 Jan 1975).

See STI/PUB—414; CONF-750109—.

The reentry drilling established communication with the top Rio Blanco detonation region at a depth of 1704 m, or about 76 m above the top detonation center. A total of 2.8 x 10^6 m^3 (97 x 10^6 ft^3) of dry gas at standard conditions has now been produced during two separate test periods. Radioactive and chemical analysis of this gas and the modeling of the stimulated reservoir shows the following main results: no permeable connection exists between the top and the middle detonation regions, since none of the tracer incorporated in the center explosive canister was detected in the gas produced. As a consequence, results for the top detonation region only are available at this time; the initial cavity radius is deduced to be 20 m (66 ft), or well within expectations; integration of the ^{85}Kr produced indicates a yield of 34 +- 3 kt for the top explosive; of the approximately 1000 Ci of tritium produced in the top explo-

sion region, about 5 percent is incorporated in the gas phase; pressure draw,down and build-up data are best reproduced by a two-layer reservoir model showing stimulated permeabilities about 10 and 30 times original formation permeabilities, and extending to a distance of about three cavity radii from the well bore; and the capacity of the reservoir intercepted by the top explosive is deduced to be about 0.2 mdarcy . m (0.73 mdarcy . ft), as contrasted with preshot estimates ranging from 1.3 to 2.3 mdarcy . m (4.1 - 7.6 mdarcy . ft). The reason for this discrepancy is not resolved at this time. Additional subsurface investigations of the other detonation regions as well as a reevaluation of the initial reservoir properties are in progress. (auth)

7281 **Nuclear in situ recovery of oil from oil shale.** Lewis, A.E. (Univ. of California, Livermore). pp 153-207 of In Peaceful nuclear explosions. IV. Vienna; International Atomic Energy Agency (1975).

From 4. IAEA panel on peaceful nuclear explosives; Vienna, Austria (20 Jan 1975).

See STI/PUB—414; CONF-750109—.

A plan is presented for production of oil by retorting oil shale in situ after breaking it with underground nuclear explosives. Reserves of oil shale of thickness and grade suitable (greater than 20 gal/ton) for this process occur in the Piceance Creek Basin of Colorado, and are estimated to contain 640 x 10^9 barrels of oil in place. Cost projections indicate that this oil could be produced at a price ranging from $2.00 to $3.30 at the well head with a 20 percent rate of return on investment (discounted cash flow). The price and production rate vary with oil shale thickness. At a rate of 32 nuclear chimneys per year in oil shale ranging in thickness from 1000 to 2000 ft, production varies from 28 x 10^6 bbl/a ($3.30/bbl) to 121 x 10^6 bbl/a ($2.00/bbl). Capital requirements for this in situ process are estimated to be 20 times less than those required by a surface retorting process. Environmental problems such as the need to dispose of large volumes of waste rock associated with conventional mining and surface retorting of oil shale would be largely avoided. De-watering problems would be similar to those associated with other methods of development. Problems of seismic ground motion and possible contamination of the oil and groundwater appear manageable. Because of its potential economic and environmental advantages, it is believed that this method should be considered for development of this vast resource. (auth)

7282 **In situ leaching of a copper deposit broken down by PNE.** Braun, R.L. (Univ. of California, Livermore); Lewis, A.E.; Mallon, R.G.; Sisemore, C.J.; Tewes, H.A.; Hard, R.A.; Klumpar, I.V.; Petrovic, L.J. pp 257-282 of In Peaceful nuclear explosions. IV. Vienna; International Atomic Energy Agency (1975).

From 4. IAEA panel on peaceful nuclear explosives; Vienna, Austria (20 Jan 1975).

See STI/PUB—414; CONF-750109—.

Copper recovery using nuclear rubblization and in-situ leaching has been studied to estimate the economic feasibility and to identify problem areas for future research and development. A plan for commercializing this chemical mining process was built around a detonation schedule of ten chimneys every three years, a leaching cycle of six years, and an annual copper production of 40,000 t. The results show that recovery using this method is profitable for a type of deposit that would be unprofitable by any conventional method. The release of radioactivity from the chimney during reentry and leaching operations, and the contamination of groundwater and copper product were studied. A careful estimate of expected radiological exposures to plant workers and to the public indicates that all exposures will be below established guidelines. (auth)

ENVIRONMENTAL SCIENCES, ATMOSPHERIC

BASIC STUDIES

7283 (BNWL-SA—5347) **Investigation of regional flow patterns for improving estimates of effluent transport and diffusion.** Elliott, D.L.; Sandusky, W.F.; Woodruff, R.K. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Sep 1975. Contract E(45-1)-1830. 24p. (CONF-751138—1). Dep. NTIS $4.00.

From Annual meeting of Pacific Northwest International Section Air Pollution Control Association; Vancouver, B.C., Canada (19 Nov 1975).

Regional wind flow patterns and transport in the lower planetary boundary layer were examined from a network of 29 wind recording stations over the Mid-Columbia Region of Washington and Oregon. Spatial and temporal variability in the computed wind fields were analyzed from hourly data during November 1974 over a study area of 170 by 190 km. Much of the surface variability in flow appears to be due to topographical effects. From an investigation of the non-frontal situations, there is evidence that regional flow types could be classified, to some extent, by surface pressure patterns. Based on this study, long-term or regional transport based entirely on 850 mb flow could be in serious error. Techniques for improving estimates of regional transport, through the adoption and modification of an existing model and the utilization of regional data are examined. Applications of these techniques to various facets, i.e., environmental impacts from potential industrial and nuclear development, are discussed. (auth)

7284 (PB—238094) **Mathematical simulation of smog chamber photochemical experiments. Final report, June 1973-74.** Hecht, T.A.; Liu, M.; Whitney, D.C. (Systems Applications, Inc., San Rafael, Calif. (USA)). Nov 1974. Contract EPA-68-02-0580. 193p. (R—74-9). NTIS $7.00.

This report deals with the continued development and testing of a general kinetic mechanism for photochemical smog formation. In line with recent experimental measurements, several rate constant values were updated, and simulations of several n-butane/NOx, propylene/NOx, and n-butane/propylene/NOx smog chamber experiments were repeated. The predictions made tend to be best at high ratios of initial hydrocarbons to NOx. A sensitivity analysis of the mechanism was carried out, and the results were combined with uncertainty estimates of the rate constants to quantify the importance of determining individual rate constants with greater accuracy. Operating parameters of the University of California, Riverside, (UCR) evacuable smog chamber were considered in detail; experimental data from this chamber will soon be used to test the mechanism further. Finally, the report discusses the validity of the steady-state approximation in simulating smog chamber experiments and some techniques for mathematically combining a number of similar organic species into general groupings. (GRA)

7285 (PB—238294) **Reactivity of polynuclear aromatic hydrocarbons with O_2 and No in the presence of light. Final report.** Geacintov, N.E. (New York Univ., N.Y. (USA). Dept. of Chemistry). Dec 1973. 35p. NTIS $3.75.

The reactivity of 20 different aromatic hydrocarbons adsorbed on solid polystyrene fluffs with oxygen and nitric oxide in the presence of light has been studied. The reaction conditions simulated those encountered in polluted atmospheres. Among the compounds studied were anthracene, pyrene, naphthalene, chrysene, benz(a)anthracene and coronene. The photoexcited triplet and singlet states of the aromatic hydrocarbons react predominantly via the quenching of the fluorescence and phosphorescence by the paramagnetic O2 and NO gases. The probability of quenching per collisional encounter and the formation of singlet oxygen depends on spin selection rules, the triplet energy, and the electron density (in the case of the monomethyl derivatives of benz(a)anthracene). NO quenching of the triplets appears to be a charge-transfer process for molecules with a high triplet energy. The most important contribution of the photoexcited aromatic hydrocarbons (per photon absorbed) to the photochemistry of atmospheres containing O2 and NO appears to be the generation of singlet oxygen, since photochemical degradation of the compounds studied was negligible compared to quenching. (GRA)

7286 (UCRL—51444-75) **Program report: FY 1975, Atmospheric and Geophysical Sciences Division, Physics Department.** Knox, J.B.; Orphan, R.C. (eds.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). 8 Oct 1975. Contract W-7405-Eng-48. 34p. Dep. NTIS $5.00.

The FY 1975 research program conducted by the Atmospheric and Geophysical Sciences Division and supporting segments at Lawrence Livermore Laboratory is reviewed briefly. Specific projects are described, and significant findings of the work are indicated. Unique numerical modeling capabilities in use and under development are described. Applications in regional atmospheric modeling, the San Francisco Bay area air pollution model, studies on the climatic effects of nuclear explosions, research on precipitation scavenging, and studies of the interaction of wind and surface dust are discussed. (CH)

CHEMICALS MONITORING AND TRANSPORT

7287 (AERE-R—8132) **Atmospheric photo-oxidation reactions. The gas phase reaction of OH radicals with some sulfur compounds.** Cox, R.A. (UKAEA Research Group, Harwell. Atomic

Energy Research Establishment). Aug 1975. 19p. Dep. NTIS (US Sales Only) $4.50. UK pounds1.00.

The effect of added Dimethyl Sulfide, Methyl Mercaptan, Carbonyl Sulfide and Hydrogen Sulfide on the photolysis of nitrous acid in air at 1 atm pressure and room temperature was studied. The results enable evaluation of the relative rates of reaction of OH radicals with these sulfur compounds and give some insight into the nature of the reactions which follow Oh attack, under conditions relevant to the lower atmosphere. The rates of oxidation of these sulfur compounds in the atmosphere are estimated on the basis of the observed reaction rates. (auth)

7288 (BNL—20546) **Individual air pollution monitors: an assessment of research needs.** Morgan, M.G.; Morris, S.C. (Brookhaven National Lab., Upton, N.Y. (USA)). 1975. 7p. (CONF-750963—3). Dep. NTIS $4.50.

From IEEE international conference on environmental sensing and assessment; Las Vegas, Nevada, USA (15 Sep 1975).

Regulatory decissions on air pollution control, which ivolve direct and indirect costs of billions of dollars, are being made without adequate knowledge of the health impacts of air pollution. The weakest link in health effects studies is probably our knowledge of individual exposures. In July of 1975, the Biomedical and Environmental Assessment group at Brookhaven National Laboratory convened a workshop titled Assessment of Research Needs in Individual Air Pollution Monitors for Ambient Air. The objectives were to develop: an estimate of how health effects experts would use individual air pollution monitors, a description of candidate instrumentation techniques, a first order evaluation of the promise held by these techniques, and a set of recommendations of national research needs in the field of individual air pollution monitors. On the basis of the data developed it is concluded that a national R and D investment totaling between 7.5 and 8 million dollars over the next five years will adequately meet our current needs for the development of individual air pollution monitors. (auth)

7289 (BNL—25041) **Some information needs for air quality modeling.** Hill, F.B. (Brookhaven National Lab., Upton, N.Y. (USA)). Sep 1975. 8p. (CONF-750572—1). Dep. NTIS $4.50.

From Workshop on sulfur and biological systems; St. Louis, Missouri, USA (30 May 1975).

The following topics were considered at the workshop: perturbation of the natural sulfur cycle by human activity; ecosystem responses to a given environmental dose of sulfur compounds; movement of sulfur compounds within the atmosphere; air quality models; contribution of biogenic sulfur compounds to atmospheric burden of sulfur; production of acid rain from sulfur dioxide; meteorological processes; and rates of oxidation of SO_2 via direct photo-oxidation, oxidation resulting from photo-induced free radical chemistry, and catalytic oxidation in cloud droplets and on dry particles. (HLW)

7290 (CEA-R—4681) **Study of photolytic aerosols at stratospheric pressures.** Delattre, P. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection). Jul 1975. 84p. (In French). Dep. NTIS (US Sales Only) $5.00.

Thesis. Submitted to Paris Univ.

An experimental study of photolytic aerosol formation at stratospheric pressure (60 Torr) and laboratory temperature was carried out previous to the exact simulation of photolytic aerosol formation in real stratospheric conditions. An experimental simulation device, techniques of generation of known mixtures of inert gases with SO_2 and No/sub x/traces at low concentration (below 1 ppm volume) and H_2O traces (a few ppm), and techniques for the determination and counting of aerosol particles at low pressures were perfected. The following results were achieved: the rate of vapor condensation on nuclei was reduced when total pressure decreased. At low pressure this influenced the working of condensation nuclei counters and the formation of photolytic aerosols. An explanation of the phenomena is proposed, as well as a means to avoid this unpleasant effect on the working of nuclei counters at low pressure. No photolytic aerosol production was ascertained at 60 Torr when water concentration was below 100 ppm whatever the concentration of SO_2 or No/sub x/ traces. With water concentration below 1200 ppm and SO_2 trace concentration below 1 ppm, the aerosol particles produced could not consist of sulfuric acid drops but probably of nitrosyl sulfate acid crystals. (auth)

7291 (COO—2428-4) **Design and implementation of a demonstration supplementary control system. Second progress report, August 1, 1974—May 31, 1975.** Ruane, M.; Greene, B. (Massachusetts Inst. of Tech., Cambridge (USA)). 1975. Contract AT(11-1)-2428. 64p. Dep. NTIS $5.50.

A Supplementary Control System (SCS) for maintaining acceptable ambient air quality has been designed. The controlled pollutant is sulfur dioxide and the SCS design includes a real-time meteorology and air quality monitoring network, periodic weather forecasting, air quality modeling and a probabilistic control strategy. Four coal burning power plants (4800 MW) in the complex terrain near Chestnut Ridge in western Pennsylvania are controlled by the design, and control actions include fuel switching, load shifting and stack gas temperature modification. The design has been implemented and is beginning its field testing period. Nine months of field data have been collected by the monitoring system and several programs have been developed to sort and analyze the data. The 24 hour standard is treatened most frequently and the background influence of Pittsburgh and Johnstown can be significant. (auth)

7292 (HASL—298) **Health and Safety Laboratory environmental quarterly, September 1—December 1, 1975.** Hardy, E.P. Jr. (Energy Research and Development Administration, New York (USA). Health and Safety Lab.). 1 Jan 1976. 201p. Dep. NTIS $8.50.

Separate abstracts were prepared for eight sections of this report. (CH)

7293 (HASL—298, pp I.83-I.106) **Halocarbons in the stratosphere.** Krey, P.W.; Lagomarsino, R.; Schonberg, M.; Frey, J.J. 1 Jan 1976.

In Health and Safety Laboratory environmental quarterly, September 1—December 1, 1975.

In April 1975 the stratospheric inventories of CCl_3F, CCl_4 and SF_6 were 260, 240 and 0.95 gigagrams, respectively. Based on the HASL box model of atmospheric transport, the three stratospheric inventories of CCl_3F measured since April 1974 are compatible with a stratospheric photolysis half life of 2 to 3 years and a total atmospheric half life of 18 to 24 years. Ratios of CCl_3F to ^{85}Kr and HT in October 1974 decrease with altitude suggesting an increasing rate of photolysis of CCl_3F with height. Stratospheric stability increases from CCl_4 less than CCl_3F less than SF_6. Ratios of the three gases suggest a stratospheric circulation pattern similar to that observed for several radioactive substances released in the stratosphere. HCl from the destruction of CCl_3F accounts for about 30 percent of the measured HCl in the stratosphere. (auth)

7294 (HASL—298(App.)) **Appendix to Health and Safety Laboratory environmental quarterly, September 1—December 1, 1975.** (Energy Research and Development Administration, New York (USA). Health and Safety Lab.). 1 Jan 1976. 495p. Dep. NTIS $11.00.

Data are tabulated on the deposition of fallout ^{90}Sr at world land sites during 1975, radionuclides and Pb in surface air, and the content of ^{90}Sr in milk and drinking water samples from various locations. (CH)

7295 (TID—26608) **Handbook on aerosols.** Dennis, R. (ed.). (GCA Corp., Bedford, Mass. (USA). GCA Technology Div.). 1976. 148p. Dep. NTIS $6.00.

The subject of aerosols is discussed extensively under the following chapter headings: objectives, organization, and applications; aerosol generation; dynamic behavior of aerosols; optical properties of aerosols; sampling and particle-size measurement; and summary tables and graphs for static and dynamic characteristics of aerosol systems. A glossary, nomenclature, and index are included. (ERB)

7296 (UCID—16927) **Response to subcommittee on environment and atmosphere.** MacCracken, M.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Oct 1975. Contract W-7405-Eng-48. 11p. Dep. NTIS $4.50.

The potential effects of chronic release of pollutants on climatic changes are discussed with regard to dose-response characteristics, ambiguities in prediction of climatic effects, ambiguities in measuring climatic effects, research approaches, and approaches to standard setting. A table is presented to show potential atmospheric effects of the following pollutants: CO_2 from fossil fuels, fluorocarbons, nitrogen oxides, ^{85}K from nuclear power plants, sulfur compounds, dusts, heat and water releases from energy generation processes, and oceanic oil slicks. (HLW)

7297 (UCRL—51920(Vol.1)) **Development of an air pollution model for the San Francisco Bay Area. Final report to the National Science Foundation. Volume I.** MacCracken, M.C.; Sauter, G.D. (eds.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Oct 1975. 227p. Dep. NTIS $7.60.

The development and verification of a regional air quality model for the San Francisco Bay Area for use as an operational tool by the local air pollution control agency, the Bay Area Air Pollution Control District (BAAPCD), has been completed during a $2^1/_2$ yr, three-agency project supported by the National Science Foundation. With source emission and meteorological information gathered by the BAAPCD and aircraft measurements taken by the

NASA Ames Research Center, results from the Livermore Regional Air Quality (LIRAQ) model developed by the Lawrence Livermore Laboratory have compared satisfactorily with observations of carbon monoxide and photochemical pollutants. The LIRAQ model can now be accessed easily by teletype and simulation runs set up on the Lawrence Berkeley Laboratory computer system. With the completion of the project, the LIRAQ model is now ready for use by the BAAPCD in its studies of air quality, land use, and control strategy assessment. Volume I of the final report presents a comprehensive overview of the project and its accomplishments. Volume 2 contains the technical appendixes. A separate User's Guide has been prepared. (auth)

7298 (UCRL—76198) **Livermore Regional Air Quality model (LIRAQ-1).** MacCracken, M.C.; Grant, K.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Oct 1975. Contract W-7405-Eng-48. 25p. (CONF-750533—7). Dep. NTIS $4.50.

From 1. AMS conference on regional and mesoscale modeling analysis and prediction; Las Vegas, Nevada, USA (6 May 1975).

The Livermore Regional Air Quality (LIRAQ) model is an Eulerian grid model developed for use in assessing the regional air quality of a region with temporally and spatially varying meteorology in complex terrain. The first implementation of this approach is embodied in the LIRAQ-1 model and is intended for use with either simple chemical systems or relatively inert pollutants. The basic model formulation is based on the conservation of mass equation integrated vertically from the surface to the base of an inversion layer, thereby creating a single layer model with a grid structure established in the two horizontal dimensions. Surface pollutant concentrations are related to vertical average concentrations using a logarithmic profile. Atmospheric transport, inversion height, source emissions, and topography are all prescribed. Data for the San Francisco Bay Area obtained during 1973 have been used in validation studies. (auth)

7299 **Environmental impact of cadmium: an overview.** Hiatt, V.; Huff, J.E. (National Library of Medicine, Washington, DC). *Int. J. Environ. Stud.*; 7: No. 4, 277-285(May 1975).

Various aspects of the effects of cadmium on the environment are reviewed. Some topics discussed are: properties and meltrods of analyses of cadmium; natural occurrences; sources of contamination, distribution, and persistence; transmission through food chains; metabolism and distribution in plants and animals; metabolism and distribution in man; toxicological effects of industrial exposure; carcinogenic and mutagenic effects; correlation of animal results to man; and comments on safe levels of exposure. (HLW)

7300 (BNWL-tr—158) **Studies of the propagation of contaminated air trails in the atmosphere. Report of results: July 1973—June 1974 (Part I).** Vogt, K.J.; Geiss, H.; Horbert, M.; Nordsieck, N.; Polster, G.; Rohloff, F. (Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany)). Oct 1975. Translation of JUL—1143-ST. 86p. Dep. NTIS $6.00.

The following experimental concepts are discussed: portable sampling network; determination of vertical concentration distribution in contaminated air trails; and simultaneous tests. The following propagation tests are described: documentation and meteorological characterization of tracer experiments; measuring results and determination of propagation parameters; comparison of different evaluation methods; determination of mean class values of propagation parameters; statistics of results of tests with 50 m emission height; and measurement of time dependence of concentration distribution close to the ground of a contaminated air trail with changes in wind direction. (HLW)

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

7301 (BNWL-B—429) **Environmental status of the Hanford Reservation for CY-1974.** Fix, J.J. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Sep 1975. Contract E(45-1)-1830. 63p. Dep. NTIS $5.45.

Environmental data collected at the Hanford Reservation during 1974 showed continued compliance of Hanford operations with all applicable State and Federal regulations. Data are presented on levels of radioactivity in samples of surface air, drinking water, Columbia River water and other surface waters, soil, and tissues of wild animals and water fowl collected at various locations. (CH)

7302 (CONF-750827—, pp 15-17) **Radiological surveillance of ERDA excess real property.** Allen, R.E. (Energy Research and Development Administration, Washington, DC). Sep 1975.

From Conference on decontamination and decommissioning of ERDA facilities; Idaho Falls, Idaho, USA (19 Aug 1975).

In Proceedings of the first conference on decontamination and decommissioning (D and D) of ERDA facilities.

The problems associated with the resurvey of the radiological condition of previously excessed real property that was associated with radioactivity are discussed and guidance toward expediting future decontamination and disposition actions of real property currently considered as excess to ERDA program needs is provided. (LK)

7303 (CONF-760202—3) **Guidelines for cleanup of uranium tailings from inactive mills.** Goldsmith, W.A.; Haywood, F.F.; Jacobs, D.G. (Oak Ridge National Lab., Tenn. (USA)). 1975. 8p. Dep. NTIS $4.50.

From 9. topical symposium on operational health physics; Denver, Colorado, USA (9 Feb 1976).

Recent experiences in Grand Junction, Colorado, have indicated the significance of uranium tailings as sources of nonoccupational exposure and suggest that current methods for perpetual care and isolation of the large areas covered by tailings piles at inactive mill locations may be inadequate for minimizing human exposure. This paper presents the rationale and the procedures used in reviewing the adequacy of proposed criteria for remedial action at these sites. Exposures due to aquatic, terrestrial, airborne, and direct contamination pathways were compared to determine the most important radionuclides in the pile and their pathways to man. It is shown that the most hazardous components of the tailings are ^{226}Ra and ^{230}Th. The long half-lives of these radionuclides require the consideration of continuous occupancy of the vacated site at some future time, even if the immediately projected land use does not anticipate maximum exposure. (auth)

7304 (CONF-760202—4) **Detection of internally deposited actinides. Part II. Statistical techniques and risk analysis.** Goans, R.E. (Oak Ridge National Lab., Tenn. (USA)). 1975. 7p. Dep. NTIS $4.50.

From 9. topical symposium on operational health physics; Denver, Colorado, USA (9 Feb 1976).

Since a considerable number of workers at Oak Ridge National Laboratory work with compounds of the transuranic elements, computer techniques have been developed to evaluate phoswich spectra in order to determine lung burdens following accidental inhalation of ^{239}Pu, ^{241}Am, ^{244}Cm or other isotopes. Two unfolding methods which have been found useful in the analysis of such cases are presented and discussed. These techniques have been used successfully to detect low levels of ^{239}Pu, ^{241}Am, ^{244}Cm, ^{233}U, ^{90}Sr, and ^{153}Gd in contaminated workers; but because of the current importance of ^{239}Pu, emphasis is placed on detection of that isotope in the presence of ^{241}Am and natural human background. In the health physics tradition of emphasizing benefit vs. risk, we also analyze uncertainties inherent in external counting of the actinides from the viewpoint of statistical risk analysis and derive decision criteria which are useful in determining whether various radioactive species have, in fact, been detected. These criteria are somewhat different from those encountered using traditional counting statistics and derive from the realization that some errors will always be made in scanning large numbers of radiation workers. The optimum decision strategy for the determination of lung burden is, therefore, one which minimizes the long-term risk of error. The usefulness of this approach to whole body counting will be discussed and analyzed. (auth)

7305 (CONF-760202—14) **Environmental monitoring of ^{41}Ar.** Sasscer, D.S.; Andreu, C. (Puerto Rico Nuclear Center, Mayaguez). 1975. 2p. Dep. NTIS $4.50.

From 9. topical symposium on operational health physics; Denver, Colorado, USA (9 Feb 1976).

The Draft Standard for Restrictions on Radioactive Effluents from Research Reactors of June 1974 recommends that the allowable concentration in unrestricted areas be reduced by a factor of fifty to 8×10^{-10} μCi/cc. The objective of this investigation was to develop a simple and accurate procedure for measuring argon-41 in unrestricted areas when this radioactive noble gas exists in concentrations significantly below the new recommended allowable concentration. These measurements were made in order to provide an accurate and simple verification of the results obtained when using prediction models for the spatial variation of the concentration of gases released from a source. The ability to measure argon-41 at a concentration which is less than 2 percent of the previously allowable value required the development of a high-sensitivity radiation detection system. The system which was developed consisted of: connecting a four inch by four inch and a three inch by a three inch sodium iodide detector in parallel; measuring concentrated samples of air in scuba tank filled to 2,200 psi by means of a high pressure pump; and obtaining low radioactive background by locating the detectors and scuba air samples tank in a lead cave with six inch thick walls. (auth)

7306 (COO—1407-58) **Rain scavenging studies. Progress report No. 11.** Dingle, A.N. (Michigan Univ., Ann Arbor (USA). Dept. of Atmospheric and Oceanic Science). May 1975. Contract AT(11-1)-1407. 85p. Dep. NTIS $6.00.

The modeling of convective storm scavenging processes is going forward on two distinct fronts. The first of these relates to the microphysical processes, particularly to the study of their response to micro-dynamical components of the convective circulation. It is found that the droplet size spectra generated are responsive to variations of vertical velocity due to turbulence within the cloud and to humidity variations due to entrainment processes. Both sets of variations give responses that differ for different amplitudes and frequencies, i.e., rapid, small-amplitude eddies appear to enhance small-droplet development, whereas slow, large-amplitude oscillations tend to enhance large-droplet development. An allied study of the assumptions used in the microphysical equations is also being made. The second modeling effort is addressed to the problem of three-dimensional representation of convective dynamics. Equations are presented, and some of the problems under attack are discussed. (auth)

7307 (COO—2736-1) **Pollen and spores as vectors of radionuclide particles at the Rocky Flats Facility, Colorado. First progress report, July 1975—14 October 1975.** Nichols, H.; Nichols, M. (Colorado Univ., Boulder (USA)). 15 Oct 1975. Contract E(11-1)-2736. 18p. Dep. NTIS $4.50.

Preliminary results are reported from a study on possibility of pollen and micro-spores as vectors of radionuclide particles at the Rocky Flats Facility, Colorado. It was found that the air samplers in use at Rocky Flats are not efficient for sampling large (50 to 100 micron) pollen particles. No large radionuclide particles were found attached to pollen. (CH)

7308 (HASL—298, pp I.2-I.6) **Continuous monitoring of urban radon-222 concentrations.** Thomas, J.W.; Fisenne, I.M. 1 Jan 1976.

In Health and Safety Laboratory environmental quarterly, September 1—December 1, 1975.

An environmental radon monitor (ERM-2) has been used to continuously measure variations in radon-222 concentration in New York City. The average ground level concentration was found to be about 100 pCi/m^3, with very little diurnal variation. (auth)

7309 (HASL—298, pp I.7-I.30) **Radioactivity distribution in the stratosphere from the Chinese high yield nuclear test of June 27, 1973.** Telegadas, K. (Air Resources Labs., Silver Spring, MD). 1 Jan 1976.

In Health and Safety Laboratory environmental quarterly, September 1—December 1, 1975.

Radioactivity concentrations and ratios in stratospheric air samples up to about 30 km describe the latitudinal and vertical spread of debris from a stratospheric source. China detonated a nuclear device, which was reported to have a total yield of 2 to 3 MT, at 40°N, 90°E on June 27, 1973. An estimate of the initial source distribution for this test and the depletion of the resulting stratospheric burden is discussed. Comparisons are made between this event and the four earlier high yield nuclear tests conducted by China, each of which was reported to have a total yield of 3 MT. (auth)

7310 (HASL—298, pp I.31-I.62) **HASL Surface Air Sampling Program. The quality of analysis, 1974 .** Toonkel, L.; Schonberg, M.; Volchok, H. 1 Jan 1976.

In Health and Safety Laboratory environmental quarterly, September 1—December 1, 1975.

The Surface Air Sampling Program systematically samples and analyzes the particulate matter in surface air for various radioactive (^{90}Sr, ^{210}Pb, ^{7}Be, ^{95}Zr, ^{137}Cs, ^{144}Ce, and ^{239}Pu) components and for stable lead. In general the quality of the analyses in the Surface Air Sampling Program in 1974 was satisfactory. The accuracy averaged within 15 percent and the mean precision was within +- 15 percent in most cases. There was a continued tendency toward a negative bias for a number of the substances analyzed. (auth)

7311 (HASL—298, pp I.63-I.82) **Global variation of Lead-210 in surface air and precipitation.** Rangarajan, C.; Gopalakrishnan, S.; Eapen, C.D. (Bhabha Atomic Research Centre, Bombay). 1 Jan 1976.

In Health and Safety Laboratory environmental quarterly, September 1—December 1, 1975.

The average activity levels of ^{210}Pb in surface air and precipitation at 105 locations (66 in the northern hemisphere and 39 in the southern hemisphere) are presented. These values have been extracted from data available in literature up to the end of 1974. The values have been tabulated along with the associated data like period of measurements, frequency of sampling, etc. The levels are also shown in graphs. Some of the basic features of the global variation of ^{210}Pb are discussed briefly. (auth)

7312 (HASL—298, pp II.1-II.6) **HASL fallout program data.** 1 Jan 1976.

In Health and Safety Laboratory environmental quarterly, September 1—December 1, 1975.

Data are presented on the content of fallout ^{90}Sr in samples of atmospheric precipitations collected during 1975 at various world land sites, in samples of drinking water, milk, human diet, and human bones collected in New York City, in samples of human diet and bones, collected in San Francisco, and in samples of human bones from countries where western-type diets are not typical. (CH)

7313 (HASL—298, pp III.2-III.48) **Environmental radioactivity annual report, 1974.** 1 Jan 1976.

In Health and Safety Laboratory environmental quarterly, September 1—December 1, 1975.

Data are presented on levels of radioactivity in samples collected in New Zealand during 1973 and 1974. Data are included on gross β activity of air and rainwater samples; the content of ^{90}Sr in samples of rainwater, milk, and human bone; the content of ^{137}Cs in samples of milk, and the content of ^{226}Ra and ^{210}Pb in samples of human bone. (CH)

7314 (NERC-LV—539-10) **Report of Animal Investigation Program activities for the Baneberry Event.** Smith, D.D.; Black, S.C.; Giles, K.R.; Moghissi, A.A. (Environmental Protection Agency, Las Vegas, Nev. (USA). Environmental Monitoring and Support Lab.). Nov 1975. Contract AT(26-1)-539. 55p. Dep. NTIS $5.45.

On December 18, 1970, an underground nuclear test, conducted at the Nevada Test Site, released radioactive materials into the atmosphere with resultant on-site and off-site contamination. The Animal Investigation Program of the National Environmental Research Center, Las Vegas developed studies to document the distribution of fission and activation products in the tissue of domestic and wild animals residing within contaminated areas on and surrounding the Nevada Test Site. A study of radioiodine secretion in milk from cows at the experimental dairy farm, including urine and fecal excretion from four of them, was started about 24 hours after the venting. A grazing intake study, which utilized fistulated steers, was also carried out. The analytical data collected from these studies are presented in this report. (auth)

7315 (PNE-RB—63(Add.)) **Project Rio Blanco radioactivity and the environment.** (CER Geonuclear Corp., Las Vegas, Nev. (USA)). Oct 1975. 36p. Dep. NTIS $5.00.

Data are presented on radiological measurements of the environment and on documenting the transfer to a subsurface disposal well of radioactive water separated from the produced gas stream. Analysis of gas and water through the drilling well control unit revealed the presence of ^{3}H and ^{85}Kr in the gas and ^{3}H, ^{137}Cs, and ^{90}Sr in the water. The production test, disposal system, and radiological monitoring system are described. Data on effluents are presented under the headings: gas and water production, radioactivity concentrations in gas, radioactivity concentrations in separator water samples, radioactivity concentrations in injected water volumes, and disposition of radioactivity. Tritium, ^{39}Ar, ^{14}C, ^{85}Kr, and ^{222}Rn were present in gas. Tritium, ^{134}CCs, ^{137}Cs, ^{90}Sr, ^{75}Se, and ^{106}Ru were present in separator water samples. Data on environmental monitoring and RB-AR-2 drilling and testing are presented under the headings air sampling, air moisture and precipitation sampling, soil sampling, water sampling, Fawn Creek sediments and algae/moss samples, bioassays, aerial surveillance, and potential environmental radiation doses. (HLW)

7316 (UCRL—51886) **Computer-controlled sampling system for airborne particulates.** Hall, C.F.; Anspaugh, L.R.; Koval, J.S.; Phelps, P.L.; Steinhaus, R.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 14 Aug 1975. Contract W-7405-Eng-48. 25p. Dep. NTIS $3.50.

A self-contained, mobile, computer-controlled air-sampling system has been designed and fabricated that also collects and records the data from eight meteorological sensors. The air-samplers are activated automatically when the collected meteorological data meet the criteria specified at the beginning of the data-collection run. The filters from the samplers are intended to collect airborne ^{239}Pu for later radionuclide analysis and correlation with the meteorological data for the study of resuspended airborne radioactivity and for the development of a predictive model. This paper describes the system hardware, discusses the system and software concepts, and outlines the operational procedures for the system. (auth)

7317 (UCRL—77106) **Ambient environmental radiation monitoring at the Lawrence Livermore Laboratory.** Lindeken, C.L.; White, J.H.; Toy, A.J.; Sundbeck, C.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 21 Nov 1975. Contract W-7405-Eng-48. 7p. (CONF-760202—2). Dep. NTIS $4.50.

From 9. topical symposium on operational health physics; Denver, Colorado, USA (9 Feb 1976).

Thermoluminescence dosimetry is the principal means of measuring ambient γ radiation at the Lawrence Livermore Laboratory. These dosimeters are used at 12 perimeter locations and 41 locations in the off-site vicinity of the Laboratory, and are exchanged quarterly. Control dosimeters are stored in a 75-mm-thick lead shield located out-of-doors to duplicate temperature cycling of field dosimeters. Effect of dosimeter response to radiation in the shield is determined each quarter. Calibration irradiations are made midway through the exposure cycle to compensate for signal fading. Terrestrial exposure rates calculated from the activities of naturally occurring uranium, thorium, and potassium in Livermore Valley soils vary from 3 to 7 μR/hr. Local inferred exposure rates from cosmic radiation are approximately 4 μR/hr. TLD measurements are in good agreement with these data. Off-site and site perimeter data are compared, and differences related to Laboratory operations are discussed. (auth)

7318 (UCRL—77520) **Atmospheric Release Advisory Capability (ARAC).** Dickerson, M.H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Nov 1975. Contract W-7405-Eng-48. 7p. (CONF-751155—1). Dep. NTIS $4.50.

From IEEE nuclear power systems symposium; San Francisco, California, USA (19 Nov 1975).

The chief purpose of ARAC data acquisition program is to provide site officials, who are responsible for ensuring maximum health protection for the endangered site personnel and public, with estimates of the effects of atmospheric releases of hazardous material as rapidly and accurately as possible. ARAC is in the initial stages of being implemented and is therefore susceptible to changes before it reaches its final form. However the concept of ARAC is fully developed and was successfully demonstrated during a feasibility study conducted in June 1974, as a joint effort between the Savannah River Laboratory (SRL) and Lawrence Livermore Laboratory (LLL). Additional tests between SRL and LLL are scheduled for December 1975. While the immediate goal is the application of ARAC to assist a limited number of ERDA sites, the system is designed with sufficient flexibility to permit expanding the service to a large number of sites. Success in ARAC application should provide nuclear facilities with a means to handle better the urgent questions concerning the potential accidental hazards from atmospheric releases in addition to providing the sites with a capability to assess the effort of their normal operations. (CH)

7319 **Problems in measuring plutonium in the environment.** Sill, C.W. (Idaho Operations Office, Idaho Falls). *Health Phys.*; **29**: No. 4, 619-626(Oct 1975).

From Proceedings of the second Los Alamos life sciences symposium; Los Alamos, NM, USA (22 May 1974).

Excellent analytical procedures are available for measuring plutonium in all kinds of environmental samples. Conditions are discussed under which complete sample decomposition and exchange with isotopic tracers are obtained, thus ensuring accuracy in the measurements. The major problems arise in obtaining sufficient samples to be statistically representative of the populations involved and in obtaining homogeneous samples for analysis. (auth)

THERMAL EFFLUENTS MONITORING AND TRANSPORT

7320 (CONF-750692—) **Proceedings of workshop on the social consequences of waste heat discharge alternatives, Argonne, Illinois, June 9—10, 1975.** Butz, B.P.; Lewis, B.A.G.; Friesema, H.P.; Halter, A.N. (Argonne National Lab., Ill. (USA)). Aug 1975. 43p. Dep. NTIS $5.25.

From Workshop on the social consequences of waste heat discharge alternatives; Argonne, Illinois, USA (9 Jun 1975).

The workshop was attended by individuals representing federal regulatory and research agencies, universities, private industry, and citizen interest groups. The staff presented papers on quantification of social consequences, environmental considerations, social considerations, and economic considerations. Participant recommendations were made with regard to the impact matrix technique, technology assessment, and the program philosophy. The principal recommendations were that site specific cases be analyzed, careful extrapolation of results be made region by region, generic impact matrices be handled very carefully or avoided, and methodology development be initiated. (HLW)

7321 **Solving the problems of thermal effects and outputs.** Jaske, R.T. pp 102-114 of In Pollution engineering techniques: an overview introduction to the problem. Ann Arbor, MI; Ann Arbor Science Publishers, Inc. (1974).

From 2. annual international pollution engineering congress; Philadelphia, Pennsylvania, USA (22 Oct 1973).

All energy used ultimately appears in the environment as a thermal release, this paper points out, and many of the measures taken to reduce other types of pollutants ultimately increase thermal pollution because energy is required to operate the pollution control equipment. A number of measures that may be taken to reduce the ratio of net energy use to gross national product are pointed out. (auth)

REGULATIONS

7322 (NP—20624) **Draft environmental statement: policies relating to electric power rates.** (Tennessee Valley Authority, Chattanooga (USA)). 1975. vp. Tennessee Valley Authority, Chattanooga, TN.

The statement discusses TVA's policies relating to the making of electric power rates, including TVA's present rate structure and various alternative rate structures. TVA proposes to continue to follow its basic long-run policies of providing an ample supply of electric power at rates which reflect as nearly as practicable the cost of providing power to each class of consumers. TVA's electric rates are in effect throughout the Tennessee Valley region, which covers an area of 80,000 square miles in Tennessee and parts of Alabama, Georgia, Kentucky, Mississippi, North Carolina, and Virginia. A variety of factors influence the demand for electricity, with price or rates being only one consideration. TVA's studies indicate that the effect of changes in electric rates on the environment is remote and not possible to trace with any degree of certainty. By adhering to a rate policy which is based on the cost of serving various classes of consumers, TVA will encourage the efficient utilization of the Nation's energy and other resources. Alternative ratemaking concepts were evaluated as a basis on which TVA might develop rate structures other than those presently in effect. These alternatives are long-run incremental cost pricing, dual rates, peak load pricing, disincentive or inverted rates, incentive rates, and lifeline rates. TVA will give full consideration to these alternatives in determining the most appropriate rate structure changes to reflect changes in load characteristics and/or system costs. (auth)

ENVIRONMENTAL SCIENCES, TERRESTRIAL

BASIC STUDIES

7323 (BNL—20301) **Computer code approach to the stability of earthen embankments.** Reich, M.; Lehner, J. (Brookhaven National Lab., Upton, N.Y. (USA)). Oct 1975. 146p. Dep. NTIS $7.60.

A computer program based on the finite element method recently developed at BNL, which combines the determination of phreatic surface with a finite element structural analysis to perform a stability evaluation of earthen embankments, is discussed. In the computer analysis, the location of the phreatic surface and the pore pressure in each soil element is first calculated. This information is then used as the input to determine the stresses throughout the soil under the influence of dead weight, pore pressure, and any external loads such as the fluid pressure from the water in the reservoir or behind the embankment. Finally, the stress state in every soil element is evaluated by a modified Mohr-Coulomb failure criterion with the tension cut-off to determine whether an incipient failure of the soil does occur. Included in Section II is an outline of the theoretical considerations relating to fluid flow problem and the stress analysis. A brief description of the failure theory used in the computer analysis is also given in this section. Section III highlights the important features of the computer code which locates the phreatic surface and determines pore pressure values. Section IV gives a detailed description of the stress analysis code and its necessary inputs. Sample problems are discussed in Section V, and a listing of the computer code appears in Section VI. (auth)

7324 (BNWL-SA—5063) **Avian populations at the ALE reservation.** Wiens, J.A. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1973. 31p. Dep. NTIS $5.00.

Studies were conducted on species composition, population densities, and standing crop biomass of small songbirds in mixed palouse-shrubsteppe habitats of the Arid Lands Ecology (ALE) reservation. Results of field studies conducted during late 1972 and 1973 are presented, as well as results of 1972 IBP population studies. An appendix is included to show territory mappings from which plot-based population density estimates were derived. (HLW)

7325 (BNWL-SA—5145) **Energy and carbon balances in cheatgrass, an essay in autecology.** Hinds, W.T. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1975. 89p. (CONF-750838—3). Dep. NTIS $7.50.

From Annual meeting of the Ecological Society of America with the American Institute of Biological Sciences; Corvallis, Oregon, USA (17 Aug 1975).

An experiment to determine the fates of energy and carbon in cheatgrass (Bromus tectorum L.) was carried out on steep (40°) north- and south-facing slopes on a small earth mound, using many small lysimeters to emulate swards of cheatgrass. Meteorological conditions and energy fluxes that were measured included air and soil temperatures, relative humidity, wind speed, incoming short-wave radiation, net all-wave radiation, heat flux to the soil, and evaporation and transpiration separately. The fate of photosynthetically fixed carbon during spring growth was determined by analysis of the plant tissues into mineral nutrients, crude protein, crude fat, crude fiber, and nitrogen-free extract (NFE) for roots, shoots, and seeds separately. (auth)

7326 (KD—3266(Rev.)) **Oak Ridge strong motion recording of the Maryville earthquake of November 30, 1973.** Beavers, J.E. (Oak Ridge Gaseous Diffusion Plant, Tenn. (USA)). Dec 1975. Contract W-7405-eng-26. 20p. Dep. NTIS $3.50.

This document discusses the strong motion recording of the November 30,1973, Maryville earthquake taken at the Energy Research and Development Administration Y-12 Plant located at Oak Ridge, Tennessee. (auth)

7327 (ORNL-tr—4068) **Salt deposits and salt mining in former Poland.** Fulda, E. Translated by R.G. Mansfield from *Kali, Verwandte Salze Erdoel.*; **34**: No. 4, 50-53(1940). 8p. Dep. NTIS $3.50.

Former Poland is rich in salt deposits, the development of which in some cases extends far back into the past. In the Miocene of the Carpathian foreland, rock salt occurs in many places, from Rybnik in upper Silesia to beyond the Rumanian border. In the German-controlled area is located the greatest common salt operation of former Poland, Wieliczka, the brine-producing plant of Barycz (for use of a soda works), and the rock salt mine of Bochnia. In the Russian zone (Ukraine) are a great many smaller saltworks and the potassium salt mines of Stebnik, Kalusz, and Holyn. Zechstein salt veins occur in the province of Posen. These are the source of the Wapno rock salt mine and the Hohensalza operations, viz. the government saltworks and the privately owned salt mine (Solvay works) which produces brine for the Montwy soda works. The small government saltworks of Ciechocinek are of no significance. Of the salt springs in the northernmost part of former Poland, that of the Druskienki spa is the best known. It probably comes from Zechstein salts at a greath depth which have not yet been reached by drilling. (auth)

7328 (ORO—748) **Oak Ridge reservation land-use plan.** (Energy Research and Development Administration, Oak Ridge, Tenn. (USA). Technical Information Center). Aug 1975. 70p. Dep. NTIS $5.50.

This document, along with the base map and overlay maps, provides a reasonably detailed description of the ERDA Oak Ridge land resources and of the current and potential uses of the land. A description of the land characteristics, including geomorphology, agricultural productivity and soils, water courses, vegetation, and terrestrial and aquatic animal habitats, is presented. Essentially all ERDA land in the Oak Ridge area is being fully used for ongoing ERDA programs or has been set aside as protected areas. Much of the land is in multiple program use. Of the 37,000 acres (14,800 ha) presently in the Oak Ridge reservation, some 1500 acres are protected from activities that would alter the land's unique character. Selective disposals, compatible with AEC program requirements and totaling some 21,000 acres began in 1949 and have continued to the present. Because the expanded role of ERDA over that of the AEC is resulting in additional land-use needs, further disposals of land must be carefully evaluated. ERDA program needs may require the acquisition of additional land. Requests for transfer of land are prompted by the need for land for such things as residential, recreational, and industrial development, highway easements, electrical transmission-line corridors, and sanitary landfill sites. Such requests for land must be critically evaluated in terms of the potential impact on current and future ERDA programs. Intensified use of existing land resources must be anticipated, and options for expansion or addition of new ERDA facilities must be recognized, including sufficient land for waste-management activities. Moreover, biomedical and environmental research programs require undisturbed watersheds, terrestrial and aquatic animal habitats, and land capable of agricultural production. (auth)

7329 (PRNC—195) **Changes in selected water quality parameters as influenced by land use patterns in the Espiritu Santo drainage basin.** Cuevas, E.; Clements, R.G. (Puerto Rico Nuclear Center, Mayaguez). Dec 1975. Contract E(40-1)-1833. 82p. Dep. NTIS $5.00.

Results are reported from a study on the effects of land use patterns on selected water quality parameters in the Espirita Santo drainage basin, Puerto Rico. (CH)

7330 (SAND—75-5742) **Mine-back mapping of hydraulic fractures.** Tyler, L.D.; Vollendorf, W.C. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1975. 3p. (CONF-751101—25). Dep. NTIS $4.50.

From Joint meeting of the American Nuclear Society and the Atomic Industrial Forum; San Francisco, California, USA (16 Nov 1975).

As part of the overall study of containment for underground nuclear testing, hydraulic fracture experiments were performed in the vicinity of tunnel complex "U12g" which is near the southeast edge of Rainier Mesa, located on the Nevada Test site. The results presented are of two forms: the mapping of the cracks formed during the fracture tests and the in situ stresses data obtained for Rainier Mesa. In horizontal boreholes the fractures appeared to initiate along an elliptical path around the borehole with no direction change of the fracture in the formation. The in situ stresses dominated the fracture behavior at the borehole and in the formation. (JSR)

7331 (US-IBP—74-3(Vol.4)) **Abstracts: US—International Biological Program. Ecosystem analysis studies.** Kemp, H.T. (ed.). (Oak Ridge National Lab., Tenn. (USA)). Nov 1975. Contract W-7405-eng-26. 75p. Dep. NTIS $5.50.

Approximately 200 abstracts are presented of studies related to the eastern deciduous forest biome, the grassland biome, and the tundra biome. The following indexes are included: author, keyword, taxonomic name, and subject category. (HLW)

7332 (USGS—474-224) **Statistical evaluation of depths calculated from gravity data.** Brethauer, G.E.; Healey, D.L. (Geological Survey, Denver, Colo. (USA)). Dec 1975. Contract AT(29-2)-474. 28p. Dep. NTIS $4.00.

A statistical evaluation to test the reliability of predicting depth to a subsurface interface beneath Yucca Flat, Nevada Test Site, was made using measured depth (y) from drill holes and calculated depth (x) from the analysis of gravity data. These data were sorted into four data sets based on relative spatial or temporal location. The results of the investigation for all data sets show that there is a strong linear relation between y and x, that the magnitude of the minimum relative uncertainty of predicting a depth is less than 10 percent at the 95-percent confidence limit, and that the difference between the slope of the calculated regression line and the slope of the ideal prediction equation can be explained as sampling variation. (auth)

7333 (ORNL-tr—4044) **New excavations in the prehistoric salt mine of the salt deposit near Hallstatt in upper Austria.** Mahr, A. Translated by R.G. Mansfield from *Forsch. Fortschr.*; **4**: No. 6, 55(1928). 3p. Dep. NTIS $4.50.

Evidence of the prehistoric mining of salt in Austria is reviewed. Archaeological specimens found in the Gruner workings, a leaching plant still in operation that is located 100m above sea level, showed that prehistoric miners penetrated at least 620 m horizontally from the mouth of the tunnel and 160 m vertically from the surface of the mountain. (CH)

7334 HYDROGEOLOGIC AND HYDROCHEMICAL FRAMEWORK, SOUTH-CENTRAL GREAT BASIN, NEVADA-CALIFORNIA, WITH SPECIAL REFERENCE TO THE NEVADA TEST SITE. Winograd, I.J.; Thordarson, W. Geological Survey Professional Paper 712-C. Washington, DC; United States of America (USA); Department of the Interior (1975). 133p. GPO.

Intensely fractured Precambrian and Paleozoic carbonate and clastic rocks and block-faulted Cenozoic volcanic and sedimentary strata in the Nevada Test Site are divided into 10 hydrogeologic units. Three of these--the lower clastic aquitard, the lower carbonate aquifer, and the tuff aquitard--control the regional movement of ground water. The coefficients of fracture transmissiblity of these rocks are, respectively, less than 1,000, 1,000 to 900,000, and less than 200 gallons per day per foot; interstitial

permeability is negligible. Solution caverns are locally present in the carbonate aquifer, but regional movement of water is controlled by variations in fracture transmissibility and by structural juxtaposition of the aquifer and the lower clastic aquitard. Water circulates freely to depths of at least 1,500 feet beneath the top of the aquifer and up to 4,200 feet below land surface. Synthesis of hydrogeologic, hydrochemical, and isotopic data suggests that an area of at least 4,500 square miles (including 10 intermontane valleys) is hydraulically integrated into one ground-water basin, the Ash Meadows basin, by interbasin movement of ground water through the widespread carbonate aquifer. Discharge from this basin--a minimum of about 17,000 acre-feet annually--occurs along a fault-controlled spring line at Ash Meadows in east-central Amargosa Desert. Intrabasin movement of water between Cenozoic aquifers and the lower carbonate aquifer is controlled by the tuff aquitard, the basal Cenozoic hydrogeologic unit. Such movement significantly influences the chemistry of water in the carbonate aquifer. Ground-water velocity through the tuff aquitard in Yucca Flat is less than 1 foot per year. Velocity through the lower carbonate aquifer ranges from an estimated 0.02 to 200 feet per day, depending upon geographic position within the flow system.Within the Nevada Test Site, ground water moves southward and southwestward toward Ash Meadows.

7335 **Spherical model calculation for volumetric response of porous rocks.** Bhatt, J.J. (Univ. of California, Berkeley); Carroll, M.M.; Schatz, J.F. *J. Appl. Mech.*; **42**: No. 2, 363-368(Jun 1975).

The problem of external pressurization and release is solved for a hollow sphere of incompressible material obeying Coulomb's law of failure. The resulting relations between the applied pressure and the porosity of the sphere are used in formulating constitutive relations for the volumetric response of porous rocks. The theoretical predictions are compared with experimental data for a sandstone and a tuff. (auth)

RADIOMETRIC TECHNIQUES

7336 (EGG—1183-1631) **Research progress in airborne surveys of terrestrial gamma radiation.** Burson, Z.G. (comp.). (EG and G, Inc., Las Vegas, Nev. (USA)). 4 Jun 1974. Contract AT(29-1)-1183. 30p. Dep. NTIS $4.00.

Progress during the last few years in airborne surveys of terrestrial gamma radiation, i.e. in the measuring, recording, and interpreting of gamma ray signals in NaI(Tl) crystals, is discussed. Non-terrestrial background contributions have been accurately characterized. The feasibility of determining the water equivalent of snow cover by aerial survey techniques has been demonstrated. Repeat surveys over areas surrounding reactor sites can now be used to detect average differences of less than 1.0 μR/hr in terrestrial gamma radiation levels. New data acquisition and recording systems allow isotope concentrations and total inventories to be measured in spatial resolutions of a few hundred feet. Aerial survey data have been combined with population distribution data to obtain population exposure values from natural terrestrial gamma radiation around reactor sites. (auth)

7337 (HASL—298, pp I.107-I.128) **Analyses of quality control samples at HASL and a contractor laboratory during 1975.** Hardy, E. 1 Jan 1976.

In Health and Safety Laboratory environmental quarterly, September 1—December 1, 1975.

Sets of biological and fallout samples analyzed at HASL and by a contractor laboratory include quality control samples which are submitted as blinds. These checks consist of blanks, reference samples analyzed repeatedly over a period of years, replicates or splits of unknowns, spikes, and duplicate samplings. This report summarizes quality control data for ashed bone, various foods, tap water, and fallout samples analyzed for ^{90}Sr, ^{137}Cs, and Ca during 1975. (auth)

7338 (LBL—4000, pp 358) **Chronology of the O. B. James Pluton.** Drake, R. (Univ. of California, Berkeley); Bowman, H.R.; Hebert, A.J. Jul 1975.

In Nuclear chemistry. Annual report, 1974.

CHEMICALS MONITORING AND TRANSPORT

7339 (CONF-750838—2) **Assessment of the microcosm as a tool for estimation of environmental transport of toxic materials.** Draggan, S. (Oak Ridge National Lab., Tenn. (USA)). Aug 1975. 18p. Dep. NTIS $4.00.

From Annual meeting of the Ecological Society of America with the American Institute of Biological Sciences; Corvallis, Oregon, USA (17 Aug 1975).

Increases in toxic chemical dissipation makes their control in the environment desirable. Environmental control of these substances requires thorough understanding of the functioning of ecosystems potentially receiving chemical input, and of the behavior and fate of released chemicals. Terrestrial microcosms are useful tools in chemical fate studies; however, critical assessment of their ability to simulate ecosystem processes has been limited. This paper provides a rationale for evaluating the utility of microcosms for prediction of chemical fate in natural ecosystems. (auth)

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

7340 (ARH—2068) **Moisture movement in soils on the Hanford Reservation.** Brownell, L.E.; Isaacson, R.E.; Sloughter, J.P.; Veatch, M.D. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). 15 Apr 1971. Contract AT(45-1)-2130. 20p. Dep. NTIS $4.50.

Methods being studied are as follows: the thermodynamic method based on water potential and thermocouple psychrometers; the tracer method using atmospheric tritium; the annual water balance based on the annual heat balance; the field lysimeter using thermocouple psychrometers; the influence of soil breathing as a result of changes in barometric pressure; and the influence of soil stratification. Progress to date has involved the installation of thermocouple psychrometers from the surface to the water table 310 feet below. These instruments are in the process of equilibration. Isothermal methods of analyzing water potential must be extended to include nonisothermal conditions which are dominant at the Hanford Reservation. Tracer techniques using tritium analyses of soil samples have successfully demonstrated that archaic water exists in virgin soil at the Hanford Reservation from a depth of approximately 7 meters to the water table, indicating that percolation has been limited to lesser depths. The annual heat balance indicates that quantities of water many times greater than the annual average precipitation of 16 centimeters can be evaporated from the soils at the Hanford Reservation during a normal summer. This indicates that the critical precipitation (P/sub c/) value may be greater than 30 to 50 centimeters of water. More precise values of the Bowen's ratio for the Hanford Reservation are required to refine this computation. The field lysimeter is perhaps the most direct method of determining the critical precipitation values for the Hanford Reservation but as yet has not been used. (auth)

7341 (BNWL-SA—5366) **Extrapolation of animal radionuclide retention data to man: the use of similarity ratios.** Thomas, J.M.; Eberhardt, L.L. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1975. Contract E(45-1). 13p. (CONF-751126—5). Dep. NTIS $4.50.

From IAEA international symposium on biological effects of low level radiation pertinent to protection of man and his environment; Chicago, Illinois, USA (3 Nov 1975).

Since radioactive retention should be a function of metabolism it follows that direct or indirect measures could be described by a "power law" based on body weight of the organism(s). However, when such "power laws" have been extended to interspecies comparisons the resulting power coefficients are usually substantially less than the value anticipated and seem to be different for each radionuclide. We propose that interspecies comparisons ought to be based on the proportionality coefficient rather than the power parameter of the power function model and have called pairwise comparisons amongst species similarity ratios. We have examined retention data from five nonruminant species (including man) where several radionuclides with different physical properties were fed. Subsequently we devised an expression whereby an estimate of biological equilibrium level in man can be calculated using similar estimates from experiments using mice, rats, or dogs. There are some statistical questions to resolve which have to do with the assumed frequency distribution for estimates of the proportionality coefficient. In addition, we have made repeated use of the same data sets. (auth)

7342 (BNWL-SA—5530) **Rapid diffusion method for physicochemical characterization of metal ligands in soils and sediments.** Garland, T.R.; Wildung, R.E.; Pelroy, R.A. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1975. Contract E(45-1)-1830. 16p. (CONF-750985—4). Dep. NTIS $4.50.

From 15. Hanford life sciences symposium; Richland, Washington, USA (25 Sep 1975).

A diffusion method is described that allows preliminary characterization of metals in soils and sediments while minimizing the potential for alteration of metal form. In addition, examples of the application of the method to model compounds of Pu in the soil are given. (ERB)

7343 (DP-MS—75-30) **Relationships among plutonium contents of soil, vegetation, and animals collected on and adjacent to an integrated nuclear complex in the humid southeastern United States.** McLendon, H.R.; Stewart, O.M.; Boni, A.L.; Corey, J.C.; McLeod, K.W.; Pinder, J.E. (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Lab.). 1975. Contract AT(07-2)-1. 23p. (CONF-751105—13; SM—199/85). Dep. NTIS $4..50.

From IAEA international symposium on transuranium nuclides in the environment; San Francisco, California, USA (17 Nov 1975).

Twenty-three representative sampling locations in and adjacent to the Savannah River Plant (SRP) site were selected to obtain information on Pu movement in the food chain under southeastern U. S. environmental conditions. Soil, a resuspendible fraction of the soil, honeysuckle (Lonicera japonica), and camphor weed (Heterotheca subaxillaris) were collected at each location. Grasshoppers and cotton rats (Sigmodon hispidus) were collected at some locations. The soil concentrations at the selected locations ranged from 1.5 fCi/g to 171 fCi/g, and alpha percentages of ^{238}Pu ranged from 2 to 66. The concentration of plutonium in the vegetation and on the leaves ranged from 0.17 to 76.1 fCi/g, and the alpha percentages of ^{238}Pu, from 3 to 61. The concentration of plutonium in cotton rats and grasshoppers ranged from 0.07 to 3.58 fCi/g, and the alpha percentages of ^{238}Pu ranged from 22 to 80. Comparisons among the Pu values of the vegetation, soil, and resuspendible fractions suggest the use of a proposed resuspendible measurement technique as a monitoring method to indicate subtle changes in the Pu concentration of the soil surface that are not detectable by routine soil sampling. Although the ^{238}Pu data in the various ecosystem components were not conclusive, they support evidence that there is an apparent increase in the biological availability of ^{238}Pu relative to the $^{239'\ 240}$ in the environment. The Pu concentrations of ecosystem components decreased as the distance from the reprocessing plants increased. (auth)

7344 (EGG—1183-1632) **Radiological survey of the area surrounding the National Reactor Testing Station, Idaho Falls, Idaho. Date of survey: 1 and 2 February 1972.** (EG and G, Inc., Las Vegas, Nev. (USA)). 4 Jun 1974. Contract AT(29-1)-1183. 21p. Dep. NTIS $4.00.

The Aerial Radiological Measuring System (ARMS) was used to survey the National Reactor Testing Station (NRTS) during February 1972. The purpose of the survey was primarily to identify the presence of Ru-106 and Rh-106 in a release from the Chemical Processing Plant at NRTS. Additionally, the gamma-ray terrestrial exposure rate levels were mapped and the distribution of any man-made isotopes was located and defined. (auth)

7345 (ORO—4066-7) **Investigation of the unusual behavior of cesium-137 and other radionuclides in the Florida environment. Progress report, September 1, 1972—September 1, 1975.** Gamble, J.F.; Ewel, K.C.; Lugo, A.E. (Florida Univ., Gainesville (USA). Inst. of Food and Agricultural Sciences). 1975. Contract E(40-1)-4066. 106p. Dep. NTIS $6.50.

Levels of fallout ^{137}Co in southeastern Florida milk indicate milk drinkers in the area have ingested 17 mrem in excess of the national average in the period 1963 to 1973. Analysis of feed in dairy rations in the area show a transfer of seven percent of activity from feed to milk. Range cattle had five times the cesium activity as meat from dairy animals. The increased amount of hay in the ration, plus higher activity levels in the unimproved pasture, account for the increase. Eighty percent of the original fallout is still active in the southeastern Florida biosystem. (auth)

7346 (ORO—4700-2) **Adsorption and diffusion of Pu in soils. Progress report, April 1, 1975—December 1975.** Brown, D.A. (Arkansas Univ., Fayetteville (USA)). 1975. Contract AT(40-1)-4700. 18p. Dep. NTIS $4.50.

Adsorption, desorption, and diffusion coefficients of ^{238}Pu were determined for three contrasting soils, Fuquay sand, Hanford sandy loam, and Muscatine silt loam. Aqueous diffusion of ^{238}Pu was determined for solutions of nitric acid, and calcium and cerium nitrate salt solutions. (auth)

TERRESTRIAL ECOSYSTEMS AND FOOD CHAINS

7347 **Transient behavior of cadmium in a grassland arthropod food chain.** Van Hook, R.I.; Yates, A.J. (Oak Ridge National Lab., TN). *Environ. Res.*; 9: No. 1, 76-83(Feb 1975).

Biological assimilation and transport of cadmium were determined for an arthropod food chain in an east Tennessee grassland community. Laboratory experiments demonstrated that there were no significant differences (P greater than 0.05) in assimilation rates (17 percent assimilation per day) or biological half-lives (7 days) of ^{109}Cd either as soluble nitrate or insoluble oxide in crickets under identical conditions. Field experiments demonstrated that primary consumers (crickets) accumulated ^{109}Cd much more rapidly (uptake rate = 0.55 day^{-1}) than did the spider predators (uptake rate = 0.08 day^{-1}). Equilibrium concentrations in crickets were obtained in 9 days (0.04 ppM cadmium), while equilibrium was not reached in spiders during the 30-day study. Food-chain concentration of cadmium did not occur as crickets accumulated levels of cadmium 60 percent of that in their vegetation food sources and spiders accumulated only 70 percent of the cadmium present in the cricket tissues. (auth)

7348 **Environmental pathways of plutonium into terrestrial plants and animals.** Hakonson, T.E. (Los Alamos Scientific Lab., NM). *Health Phys.*; 29: No. 4, 583-588(Oct 1975).

From Proceedings of the second Los Alamos life sciences symposium; Los Alamos, NM, USA (22 May 1974).

In evaluating the occupational environment to assess its hazard potential from the presence of plutonium, measurements must be made on the physical environment and on the worker. The most significant of the former are measurements of plutonium air concentration supplemented by particle size and duration of exposure estimates. These can only be very approximately estimated because of various compromises which must be made and are most useful as indicators of the effectiveness of the containment. Measurements on the worker such as urine assay and chest counting for plutonium also involve compromises and their interpretation involves assumptions based on limited and variable data. Information from analysis of tissue samples shows only a rough correlation with calculations based on urine assay data. Nevertheless, assemblage of all pertinent information from these measurements does permit real control of potential health hazards from work with plutonium. (auth)

7349 **Evaluation of plutonium at Eniwetok Atoll.** Wilson, D.W.; Ng, Y.C.; Robinson, W.L. (Univ. of California, Livermore). *Health Phys.*; 29: No. 4, 599-611(Oct 1975).

From Proceedings of the second Los Alamos life sciences symposium; Los Alamos, NM, USA (22 May 1974).

An extensive survey was carried out in 1972 to 1973 to assess the current radiological status of Eniwetok Atoll. The radionuclides detected in the Atoll environment were studied for their potential contributions to the dose commitment of the returning population according to several pathways of exposure. Plutonium was detected in air and in the terrestrial and aquatic environment at concentrations that varied from background levels due to world-wide fallout to levels several orders-of-magnitude above. The dose commitments from plutonium via the terrestrial food chain and inhalation vary according to the postulated living pattern. The dosages via marine foods can be expected to be insensitive to living pattern and to exceed those via terrestrial foods. Plutonium would contribute nearly all of the dosage via inhalation, but this pathway ranks low in overall importance compared with the food-chain and external-dose pathways. Although the potential dose from plutonium via all pathways is low relative to that from ^{60}Co, ^{90}Sr and ^{137}Cs, plutonium will still remain in the Atoll environment after the other major isotopes have decayed away. (auth)

THERMAL EFFLUENTS MONITORING AND TRANSPORT

7350 **Thermal tolerance and biochemical polymorphism of immature largemouth bass Micropterus salmoides lacepede.** Smith, M.H. (Savannah River Ecology Lab., Aiken, SC); Scott, S.L. *Bull. Ga. Acad. Sci.*; 33: No. 4, 180-184(Sep 1975).

Immature largemouth bass were collected by seining from Par Pond Reservoir, taken to the laboratory, and slowly acclimated at temperatures of 20, 28, and 36°C. At 36°C none of the fish survived the one week acclimation period. Mortality rates of fish acclimating at lower temperatures were significantly less. The critical thermal maximum of each bass was determined by observing the point at which the fish lost its sense of orientation and equilibrium. Allele frequencies were essentially the same among fish surviving the acclimation process as in the parental population. (HLW)

SITE RESOURCE AND USE STUDIES

7351 (ANL/AA—2) **SITE: a methodology for assessment of energy facility siting patterns. Regional studies program.** Frigerio, N.A.; Habegger, L.J.; King, R.F.; Hoover, L.J.; Clark, N.A.; Cobian, J.M. (Argonne National Lab., Ill. (USA)). Aug 1975. Contract W-31-109-Eng-38. 116p. Dep. NTIS $5.45.

The timely development of the nation's energy production capacity in a manner that minimizes potential adverse local and regional impacts associated with energy facilities requires the use of sophisticated techniques for evaluation of siting alternatives and

fuel cycle options. This report is a documentation of the computerized SITE methodology that has been developed for evaluating health, environmental, and socioeconomic impacts related to utilization of alternate sites for energy production within a region of interest. The cost, impact, and attribute vectors, which are generated and displayed on density maps, can be used in a multiparameter overlay process to identify preferable siting areas. The assessment of clustered facilities in energy centers is also possible within the SITE analysis framework. An application of the SITE methodology to Northern Illinois is presented. Also included is a description of the ongoing extension of SITE for the accumulative evaluation of alternative regional energy siting patterns and fuel cycle options. An appendix provides documentation and user information for the SITE computer program. (auth)

7352 (CONF-751064—2) **Defining of industrial location criteria at the site level: an empirical analysis using aerial photography.** Honea, R.B. (Oak Ridge National Lab., Tenn. (USA)). 1975. 34p. Dep. NTIS $5.00.

From Proceedings of American Society of Photogrammetry; Phoenix, Arizona, USA (26 Oct 1975).

The advantages of aerial photography in the selection of industrial sites are discussed. Applications in the regional analysis of land use for a 6,500 square mile area in East Tennessee are discussed. (CH)

7353 (PNE-WW—40) **Ecological considerations for Project Wagon Wheel and hydraulic fracturing activities. Phase II(a). Annual summary report for 1974.** Whicker, F.W.; Alldredge, A.W.; Fisser, H.G.; Post, G. (El Paso Natural Gas Co., Tex. (USA)). Aug 1975. 38p. Dep. NTIS $5.00.

Vegetation studies were conducted to obtain data on production and biomass of shrubs and mat-forming woody plants. Tables are presented to show data for various species of plants. Aquatic studies were conducted to obtain data on benthic fauna and physical water conditions. Tables are presented to show classification of organisms per square foot of river bottom, ice thickness at water sampling locations, and stream velocities along the base of each study bluff. Mammalian studies were conducted to obtain population data on deer, mice, least chipmunk, northern grasshopper, mouse, ground squirrels, and prairie dogs. Observations were also made on antelope, moose, and mule deer. Hydraulic fracturing activities included studies on physical perturbations, vegetation documentation, and small mammal documentation. (HLW)

7354 (UCRL—51948) **Average properties of nuclear test areas and media at the USERDA Nevada Test Site.** Ramspott, L.D.; Howard, N.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Sep 1975. Contract W-7405-Eng-48. 40p. Dep. NTIS $4.00.

Data have gradually been accumulated on the physical properties of nuclear test sites at the U. S. Energy Research and Development Administration (USERDA) Nevada Test Site (NTS) since underground testing began there in 1957. These data have been stored in the Lawrence Livermore Laboratory (LLL) K-Division Test Effects Data Bank. This report briefly describes the principal test areas Yucca Flat, Pahute Mesa, and Rainier Mesa) and media (alluvium, tuff, Climax Stock (granite) and Paleozoic rocks) at NTS. Background information is given on the data base and the various methods used to measure geophysical parameters at NTS are described. The mean, standard deviation, and range of values for each test area and medium are given. However, specific properties for individual sites are not contained in this report. Properties for which averages are given include overburden and working-point density; seismic velocity both near the working point and from the working point to the surface; and water content, porosity, and water saturation of the rocks in the working point vicinity. (auth)

7355 (USGS—474-211) **Supplementary lithologic logs and stratigraphic identifications for exploratory and emplacement drill holes in areas 3, 4, and 7, Nevada Test Site.** Dixon, G.L.; Quinlivan, W.D.; Ray, J.M.; Ohl, J.P. (Geological Survey, Denver, Colo. (USA)). Nov 1975. Contract AT(29-2)-474. 93p. Dep. NTIS $5.45.

This report is a supplementary compilation of lithologic logs of exploratory and emplacement holes in Areas 3, 4, and 7, Nevada Test Site, with emphasis on identification of Tertiary volcanic units. An index map showing locations of the drill holes is included. (auth)

7356 (USGS—474-219) **Determination of in situ stress in U12g tunnel, Rainier Mesa, Nevada Test Site, Nevada.** Ellis, W.L.; Ege, J.R. (Geological Survey, Denver, Colo. (USA)). Jan 1976. Contract E(29-2)-474. 19p. Dep. NTIS $3.50.

Stress relief borehole-deformation measurements using the U. S. Bureau of Mines overcore technique were made at a depth of 442 m below Rainier Mesa, Nevada Test Site. The measurements, made in three noncoplaner boreholes drilled in low-modulus, low-density, volcanic rocks, were used to calculate the three-dimensional stress field. All stresses were found to be compressive. The calculated vertical stress component of 67 bars is consistent with the estimated vertical stress attributed to overburden. The maximum principal stress(85 bars) trends N 21°E and the minimum principal stress (26 bars) trends N 68°W; both are nearly horizontal. Synthesis of geologic and geophysical data by other workers indicates a similar orientation of the maximum and minimum horizontal stresses on a regional scale. (auth)

7357 (USGS—474-223) **Reconnaissance gravity survey of central Nevada.** Healey, D.L. (Geological Survey, Denver, Colo. (USA)). 1967. Contract AT(29-2)-474. 11p. Dep. NTIS $4.50.

Submitted in the report is a reconnaissance gravity map (scale 1:250,000) based on 1,475 stations for an area of 8,500 square miles (22,015 km^2) in central Nevada. Included is a table showing average rock densities obtained from gamma-gamma logs run in 11 drill holes. The interpretation of gravity data is highly dependent upon the bulk density of the buried rocks and alluvium and upon the assumption of the regional gradient. The reconnaissance gravity data are being interpreted using in situ bulk density data obtained from continuous gamma-gamma density logs. The average density for 9,433 feet (2,875 m) of Quaternary alluvium is 2.03 g/cm^3 (excluding data from Hot Creek Valley). The average density for 9,424 feet (2,872 m) of Tertiary volcanic rock is 2.34 g/cm^3. A tentative regional gradient, based on the average elevation within a 39.8-mile (64-km) radius of each of 34 stations located on Paleozoic sedimentary rock, was computed by the method of least squares. (auth)

ENVIRONMENTAL SCIENCES, AQUATIC

BASIC STUDIES

7358 (CONF-751066—1) **Susceptibility of threadfin shad to impingement.** Griffith, J.S.; Tomljanovich, D.A. (Oak Ridge National Lab., Tenn. (USA); Tennessee Valley Authority, Norris (USA)). 1975. 26p. Dep. NTIS $4.50.

From Southern division of American Fisheries Society meeting; Norris, Tennessee, USA (12 Oct 1975).

Threadfin shad (Dorosoma petenense) impingement at 13 Tennessee Valley Authority electric generating facilities was monitored from August 1974 through June 1975 to assess possible mortality resulting from low water temperature. Concurrent experiments were conducted to evaluate the ability of cold-stressed threadfin shad to avoid impingement. In the laboratory, temperatures of 12°C stressed threadfin shad and those below 8°C caused high impingement mortality. At 5 of 12 fossil-fuel plants 85 percent or more of the annual impingement occurred when water temperatures were below 10°C. At 4 plants impingement was not related to low temperatures. Impingement at Browns Ferry nuclear plant correlated generally with low water temperatures but individual impingement peaks were not consistently associated with temperature shocks. (auth)

7359 (COO—2689-2) **Seabed disposal program: geochemical and sedimentological studies of North Pacific sediments. Progress report, July 1, 1975—September 30, 1975.** Heath, G.R. (Rhode Island Univ., Kingston (USA). Graduate School of Oceanography). 1975. Contract E(11-1)-2689. 4p. Dep. NTIS $3.50.

Reduction of field data for study area MPG-2 (33°20'N, 151° 00'W) has established that sedimentation rates during the past 20 million years have varied by less than a factor of two over distances of tens of kilometers. These variations have been uniform through time, indicating that catastrophic events have not disturbed sediments in this area. Manganese nodules from the MPG-2 area are not economically attractive. (auth)

7360 (COO—3565-5) **Marine microbiology. Progress report, July 31, 1974—September 30, 1975.** Watson, S.W. (Woods Hole Oceanographic Institution, Mass. (USA)). 1975. Contract AT(11-1)-3565. 45p. Dep. NTIS $4.00.

These studies have been concerned with the role bacteria play in the mineralization of organic matter and the utilization of energy in inshore marine environments. Specifically we have worked on techniques which will permit us to more clearly define the concentration and distribution of bacteria and to determine

what percent of the total biomass is composed of bacteria. Studies were carried out in Buzzards Bay during 1974 to 75. These studies suggest that bacteria utilize 50 to 90 percent of the energy which is captured by photosynthetic processes. Approximately 53 grams of organic carbon are mineralized/m²/yr in the sediments and 100 grams of organic carbon are mineralized in the water column/m²/yr. The average total microbial biomass in the water column was found to be 2.72 grams of C/m² while the average bacteria biomass was 1.4 grams of C/m². These studies suggest bacteria use more energy in inshore water than any other trophic level. (auth)

7361 (PRNC—190) **Manual for hydrographic cruises.** Wood, E.D. (Puerto Rico Nuclear Center, Mayaguez). May 1975. Contract AT(40-1)-1833. 77p. Dep. NTIS $6.00.

The manual is intended to serve as a guide to persons planning and executing hydrographic cruises and those who interpret and evaluate the resulting data. The following topics are discussed: hydrographic procedures; hydro team; steps for use of station log sheet; Marsden squares; oceanographic codes and tables; oxygen titration; computer programs; and temperature and depth calculations. (HLW)

CHEMICALS MONITORING AND TRANSPORT

7362 (CONF-751058—1) **Distribution and bioaccumulation of mercury in biotic and abiotic compartments of a contaminated river-reservoir system.** Hildebrand, S.G.; Andren, A.W.; Huckabee, J.W. (Oak Ridge National Lab., Tenn. (USA)). Oct 1975. 27p. Dep. NTIS $5.00.

From Workshop on toxicity to biota of metal forms in natural waters; Duluth, Minnesota, USA (7 Oct 1975).

The distribution and bioaccumulation of mercury in the North Fork of the Holston River—Cherokee Reservoir which receives mercury inputs from an abandoned chlor-alkali plant were studied to determine the behavior and ultimate fate of mercury in this system. Mercury in the dissolved form appears to be leaching from waste disposal ponds at the abandoned plant. Dissolved mercury is rapidly adsorbed onto suspended particulates and the main downstream transport of mercury appears to take place in the particulate phase. Total mercury and methylmercurials in fish and benthic invertebrate taxa are highest immediately below the mercury source then decrease downstream. This pattern is similar to the downstream distribution of mercury in the water and sediments. Total mercury in rockbass (Ambloplites rupestris) 83 miles downstream from mercury inputs exceeds 1.0 ppM. Approximately 80 percent of mercury in fish species in the river is methylmercury and on the order of 50 percent of mercury in benthic invertebrates is methylmercury. We have not detected methylmercury in bed sediments in this system. Dietary uptake of methylmercury by fish species feeding on benthic invertebrates may be a significant route of entry of methylmercury into food webs in this river. Future research necessary to more completely understand the biogeochemical cycling of mercury in aquatic ecosystems is suggested. (auth)

7363 (COO—2532-1) **Combined toxicity effects of chlorine, ammonia, and temperature on marine plankton. Progress report, February 1, 1975—September 15, 1975.** Ryther, J.H.; Goldman, J.C. (Woods Hole Oceanographic Institution, Mass. (USA)). Oct 1975. Contract AT(11-1)-2532. 84p. Dep. NTIS $5.00.

Research on the combined effects of chlorine, ammonia, and temperature on marine plankton have been carried out for 7½ months. Continuous-flow bioassay units have been constructed for larval species, juvenile fish, and phytoplankton. A detailed study on lobster (Homarus americanus) larvae and other studies on killifish (Fundulus heteroclitus) larvae and juveniles, and juvenile scup (Stenotomus versicolor) and winter flounder (Pseudopleuronectes americanus) have been performed. Results to date indicate that there is an apparent and, as yet undetermined, chlorine demand of seawater; there is a differential toxic effect of chlorine and chloramines—lobsters were more sensitive to chloramines, whereas the fish species were more affected by free chlorine; respiration results indicate that significant stress occurs at toxicant levels below the onset of mortality, thus raising questions regarding the applicability of standard bioassay data; temperature elevation exerts a strong synergistic effect on chlorine-chloramine toxicity; and effects of exposure to halogen toxicity appear irreversible as revealed by persistent reductions in metabolic activity. It appears that chlorine toxicity to marine biota can occur even though chlorine residuals cannot be detected by current analytical techniques. These results support the findings of others that chlorine toxicity is a serious environmental pollutant. (auth)

7364 (DP—1395) **Removal of mercury from aqueous solutions by shredded rubber.** Russell, E.R. (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Lab.). Oct 1975. Contract AT(07-2)-1. 9p. Dep. NTIS $4.00.

Shredded or ground rubber absorbs mercury from aqueous solutions. Mercury concentration was reduced from 100 ppm to less than detectable levels (5 ppm) by passing the solution through a column of finely divided tire rubber. Treatment of the rubber with sulfide solutions increases mercury removal capacity by 25%. Mercury cannot be eluted quantitatively, but may be recovered by destructive distillation of the rubber. (auth)

7365 (N—75-22937) **Water hyacinths and alligator weeds for removal of lead and mercury from polluted waters.** Wolverton, B.C.; McDonald, R.C. (National Aeronautics and Space Administration, Bay St. Louis, Miss. (USA). National Space Technology Labs.). 11 Apr 1975. 14p. (NASA-TM-X—72723). NTIS $3.25.

Removal of lead and mercury by water hyacinths (Eichhornia crassipes) (Mart.) Solms and alligator weeds (Alternanthera philoxeroides) (Mart.) Griesb. was investigated. Water hyacinths demonstrated the ability to remove 0.176 mg of lead and 0.150 mg of mercury per gram of dry plant material from distilled water and river water in a 24-hour period. One acre of water hyacinths is potentially capable of removing 105.6 grams of lead and 90.0 grams of mercury per day. Alligator weeds removed 0.101 mg of lead per gram of dry plant material in a 24-hour period. This same plant also demonstrated the ability to remove a minimum of 0.153 mg of mercury per gram of dry plant material in a six hour period. (STAR)

7366 (SAND—75-5869) **Heavy metals in estuarine benthic organisms and sediments: data and model.** Wayland, J.R.; Baker, J.H.; Ivy, J.T.; Bedinger, C.A. Jr. (Sandia Labs., Albuquerque, N.Mex. (USA)). 5 Sep 1975. 32p. (CONF-750967—14). Dep. NTIS $4.75.

From 3. ERDA environmental protection conference; Chicago, Illinois, USA (23 Sep 1975).

Coastal industrial development and subsequent heavy metal release requires an understanding of environmental contamination that can result. A dynamic model has been developed in close association with a detailed environmental surveillance program of an estuarine ecosystem. The program and model traces the heavy metals from release into the water column and subsequent interactions between the air-water interface, pelagic zone, and sediments. The interaction between phytoplankton, zooplankton, benthic organisms, and predators is accounted for. The results of the calculations are compared to measurements taken in an estuarine ecosystem over a two-year period. (auth)

7367 **Distribution of some trace elements in black sea and their flux between dissolved and particulate phases.** Brewer, P.G.; Spencer, D.W. (Woods Hole Oceanographic Institution, MA). *Am. Assoc. Pet. Geol. Bull.*; No. 20, 137-143(1974).

The trace-element geochemistry of the Black Sea is dominated by the strong pycnocline separating the oxygenated and reducing environments. Using values of the vertical advective velocity and vertical eddy-diffusion coefficient derived from a model, the flux of dissolved sulfide, manganese, iron, copper, and zinc through this interface was estimated. The calculated sulfide flux of 145 mM/m²/year is smaller than estimates of sulfide production in the sediments by a factor of four, but is consistent with estimates of chemosynthesis, suggesting that a sulfide-removal mechanism not explained by the model must operate. From the manganese data, deductions were made that about 78 percent of the detrital load of rivers entering the Black Sea is deposited near the mouth of the river and only 22 percent is spread over the surface of the Black Sea. If the mean sinking rate is 1,000 m/year, the data on the distribution and elemental composition of particulate matter in the Black Sea are in agreement with estimates of river input. (auth)

7368 (BNWL-tr—160) **Warning test to detect the presence of highly toxic concentrations of poisons in water.** Besch, W.K.; Loseries, H.G.; Meyer-Waarden, K.; Schmitz, W. Translated from *Arch. Hydrobiol.*; **74**: No. 4, 551-565(1974). 20p. Dep. NTIS $4.50.

The design is described of a testing tank for fish to detect the presence of highly toxic substances (phenols, DDT) in drinking water supplies, river water, and sewage. The swim behavior of test fish is used as the criteria and the ability of the fish to swim against a current, maintain their position in a horizontal current, and avoid mild electric shock are measured using a photoelectric system. Data are included on the relative sensitivity to temperature and toxic substances of carp (Cyprinus carpio), goldfish (Carassius aurius), orfe (Idus melanotus), and rainbow trout (Salmo gairdneri). (CH)

7369 Dissolved yellow organics: quantitative and qualitative aspects of extraction by four common techniques. Milanovich, F.P.; Ireland, R.R.; Wilson, D.W. (Univ. of California, Livermore). *Environ. Lett.*; 8: No. 4, 337-343(1975).

Naturally occurring compounds, responsible for the yellow color of particulate-free natural water, have been generally referred to as yellow substance or yellow organic acids. The dissolved yellow organic matter was removed from aliquots of the same freshwater sample by four common techniques: lyophilization, ion-exchange, ultrafiltration and organic solvent. Quantitative and qualitative aspects of the recovery, including fractionation by gel filtration and total nitrogen determinations, are presented. (LR)

7370 Determination of trace organics in municipal sewage effluents and natural waters by high-resolution ion-exchange chromatography. Pitt, W.W. Jr.; Jolley, R.L.; Scott, C.D. (Oak Ridge National Lab., TN). *Environ. Sci. Technol.*; 9: No. 12, 1068-1073(Nov 1975).

Automated, high-resolution ion-exchange chromatographs, previously developed for the analysis of the molecular biochemical constituents in human body fluids, have been applied to the analysis of various polluted waters. Samples of polluted waters have been collected from selected sources, concentrated up to 10,000-fold, and chromatographed on high-pressure ion-exchange columns. Monitoring of the column eluates for ultraviolet absorbance and cerate oxidizability has revealed the presence of numerous organic contaminants, many of which have been subsequently identified by auxiliary techniques such as mass spectrometry. In the primary and secondary effluents from a domestic sewage treatment plant, 56 and 13 organics, respectively, have been identified and quantified. A total of 16 different organics have been identified in samples from five different natural waters. (auth)

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

7371 (CONF-751105—9) **Plutonium and americium in Lake Michigan sediments.** Edgington, D.N.; Alberts, J.J.; Wahlgren, M.A.; Karttunen, J.O.; Reeve, C.A. (Argonne National Lab., Ill. (USA)). 1975. Contract W-31-109-Eng-38. 14p. (SM—199/47). Dep. NTIS $4.50.

From IAEA international symposium on transuranium nuclides in the environment; San Francisco, California, USA (17 Nov 1975).

The vertical distributions of $^{239,240}Pu$, ^{238}Pu, and ^{137}Cs have been measured in sediment cores taken from Lake Michigan. Sections from a limited number of cores have been analyzed for ^{241}Am. In addition, grab samples from ten locations in the southern basin of the lake have been analyzed for phase distribution of $^{239,240}Pu$ using a sequential extraction technique. The results indicate that the $^{239,240}Pu$, ^{238}Pu, and ^{137}Cs from weapons testing, and the ^{241}Am formed in situ are concentrated in the sediments. A comparison of the total deposition of $^{239,240}Pu$ and ^{137}Cs indicates that ^{137}Cs may be valuable as a monitor for $^{239,240}Pu$ deposition in the sediments. Values of the $^{238}Pu/^{239,240}Pu$ ratio are in agreement with values reported in Lake Ontario sediments (and Lake Michigan plankton) and show little variation with depth. ^{241}Am data support the concept of in situ production with little preferential mobility after formation. Studies of sedimentary phase distributions show that $^{239,240}Pu$ is associated with hydrous oxide phases which are chemically stable under the prevailing conditions in lake sediments. Since Lake Michigan sediments remain aerobic, relatively little $^{239,240}Pu$ is available for chemical mobilization from the hydrous oxide or organic phases present in the sediments. (auth)

7372 (DP-MS—75-26) **Removal of plutonium from drinking water by community water treatment facilities.** Corey, J.C.; Boni, A.L. (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Lab.). 1975. Contract AT(07-2)-1. 12p. (CONF-751105—11; SM—199/81). Dep. NTIS $4.50.

From IAEA international symposium on transuranium nuclides in the environment; San Francisco, California, USA (17 Nov 1975).

Plutonium removal factors (RF) averaged 14 +- 10 during a study of the effectiveness of three drinking-water treatment plants for removing Pu from Savannah River water. Plutonium concentrations between 0.1 and 3.5 femtocurie/l were measured in raw and finished water samples. From 50 to 10,000 liter samples of water were concentrated by ion exchange techniques and processed to determine the concentrations of ^{239}Pu and ^{240}Pu and to derive Pu RF's. The similarity between RF's observed for both Pu and suspended solids suggests a colloidal behavior for Pu. Plutonium RF's may be limited by low-level buildup on the treatment facility filters and subsequent bleeding into finished water, and thus may be higher during abnormal Pu releases to the environment. Flocculation and filtration appear to be the primary factors in the water treatment process contributing to Pu removal. The similarity between the plutonium contents of finished water from treatment facilities upstream and downstream of the Savannah River Plant (SRP) indicates that there is no measurable dose-to-man from SRP Pu releases in the water. The 70-year bone dose commitment to an individual from consumption for one year of 1.65 liters per day of treated Savannah River water, based on the Pu concentrations of finished waters from the three treatment facilities, is 5×10^{-5} em. (auth)

7373 (DP-MS—75-28) **Plutonium in Atlantic coastal estuaries in the southeastern United States.** Hayes, D.W.; LeRoy, J.H.; Cross, F.A. (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Lab.). 1975. Contract AT(07-2)-1. 23p. (CONF-751105—10; SM—199/84). Dep. NTIS $4.50.

From IAEA international symposium on transuranium nuclides in the environment; San Francisco, California, USA (17 Nov 1975).

A survey was made to begin to provide baseline information on the Pu distribution of representative estuarine and coastal areas of the southeastern United States. Sediments and marsh grass (Spartina) were collected and analyzed from three locations within a tidal marsh. In three estuaries (Savannah, Neuse, and Newport), the suspended particulate matter (1 μm and greater) was filtered from waters with different salinities, and the plutonium content of the particulates determined. The Savannah River estuary, in addition to fallout Pu, has received up to 0.3 Ci of Pu from the Savannah River Plant (SRP) of the U. S. Energy Research and Development Administration. The SRP plutonium has a variable isotopic composition that can influence Pu isotopic ratios in the estuarine system. The other estuaries do not have nuclear installations upstream. Data are included on the content of ^{238}Pu, ^{239}Pu, and ^{240}Pu in sediments and marsh grass of the Savannah River estuary. (CH)

7374 (NVO—269-26) **Bioenvironmental studies, Amchitka, Island, Alaska, 1975 task force report.** Nelson, V.A. (comp.). (Washington Univ., Seattle (USA). Coll. of Fisheries). Dec 1975. Contract E(26-1)-269. 20p. Dep. NTIS $4.50.

Bioenvironmental studies at Amchitka Island, Alaska, have been sponsored by the Atomic Energy Commission-Nevada Operations Office (now U. S. Energy Research and Development Administration-Nevada Operations office) since 1967 when the Island was selected as the site for two underground nuclear weapons tests, Milrow in October 1969, and Cannikin in November 1971. This report presents the findings of a field survey on Amchitka during the period of 8 August through September 9, 1975. A background radiation survey conducted on the Island revealed that levels of radioactivity on Amchitka remain comparable to levels in other areas of the United States. Samples of plants, animals, soil and water were also collected for radiometric analyses in the home laboratory. Results of the tritium analyses of the water samples (excepting those from the Long Shot area) indicated that ^{3}H values are what would be expected at an island station at a similar latitude in the northern hemisphere. The Long Shot mud pits and their drainage system remain contaminated with ^{3}H. The ^{3}H concentration is less than in the rainfall at Vienna, Austria, in 1963. Results of the other radiometric analyses will be reported later. The spawning run of pink salmon was surveyed in 20 streams. The 16 to 19 salmon counted in 1975 was greater than the 5 counted in the brood year, 1973, but was still appreciably lower than the 100 fish estimated for 1971. The disturbed areas reseeded in 1973 with Boreal creeping red fescue, high-light chewings fescue, Bering hairgrass, and annual ryegrass exhibited good growth of the fescue and hairgrass emerging through a dense mulch of dead ryegrass stems and leaves from the first two seasons of growth. The fungus discovered growing in some of the reseeded areas in 1974 was identified as Corticium fuciforme. The fungus was not found on native vegetation adjacent to the plots. (auth)

AQUATIC ECOSYSTEMS AND FOOD CHAINS

7375 Plutonium in aqueous systems. Schell, W.R. (Univ. of Washington, Seattle); Watters, R.L. *Health Phys.*; 29: No. 4, 589-597(Oct 1975).

From Proceedings of the second Los Alamos life sciences symposium; Los Alamos, NM, USA (22 May 1974).

A review has been made of the available information concerning plutonium in the aquatic environment. The levels are low and the data on the environmental concentrations in the lake and marine environment are very limited. Of particular relevance to biological accumulation processes is the physical-chemical state of plutonium. Limited information is available in natural environmen-

tal waters. Indications are that the plankton has the highest concentration factors and that the concentration factors decrease with increasing complexity of the organisms. Recent studies of plutonium in water, sediment, and biota at Bikini and Eniwetok Atolls are given. The water samples measured indicate that plutonium exists in the particulate, soluble, and colloidal physical-chemical states. The plutonium is being injected into the water column from the sediments and has not been removed from the biogeochemical cycle after 16 yr. Concentrations of plutonium in vertebrates and invertebrates measured at Eniwetok were low and ranged from 0.001 to 0.2 pCi/g wet in fish muscle. Additional data are required to better evaluate the potential hazards to man of plutonium in the aquatic environment. (auth)

7376 ^{137}CCs and ^{40}K in the flesh of Pacific albacore, 1964—1974. Young, D.R. (Southern California Coastal Water Research Project, El Segundo); Folsom, T.R.; Hodge, V.F. *Health Phys.;* **29**: No. 5, 689-694(Nov 1975).

Concentrations of ^{137}Cs in the flesh of albacore tuna caught off the California coast during the last 10 yr decreased by a considerably smaller factor than did corresponding values reported for atmospheric fallout. Between 1965 and 1974, average tissue concentrations decreased steadily from 90 to approx 40 pCi/wet kg, which suggests an effective half-time for ^{137}Cs in the upper layer of the eastern North Pacific of about 1 decade. Values for natural ^{40}K, which was measured at the same time, averaged 3300 pCi/wet kg. The 1965 mean concentrations of ^{137}Cs in albacore from four widely separated fisheries in the Northern Hemisphere agreed within a factor of two, ranging from 50 to 90 pCi/wet kg. In contrast, specimens from South Pacific fishery based at American Samoa averaged only 14 pCi/wet kg. Surface seawater collected around Tutuila Island averaged 0.085 pCi/l. ^{137}Cs, in good agreement with measurements made a year later over a much wider area of the South Pacific. No large variations in flesh concentrations of ^{137}Cs or ^{40}K were observed as a function of tuna size, species, portion of the body sampled, or cooking. Thus, radioanalysis of canned tuna may be an efficient method of following major changes in ^{137}Cs contamination of upper layers of the world ocean. (auth)

THERMAL EFFLUENTS MONITORING AND TRANSPORT

7377 (PB—238965) **One dimensional stream excess temperature analysis.** Bauer, D.P.; Mackenroth, E. (Geological Survey, Bay St. Louis, Miss. (USA). Gulf Coast Hydroscience Center). Nov 1974. 35p. (WSGS-WRD—75-003). NTIS $3.75.

The program is based on a one dimensional stream excess temperature model and predicts the decay of excess heat as well as soluble contaminants as the first-order reaction process in an ambient flowing stream. The model is intended for use in portraying the surface exchange losses of a thermally uniformly mixed stream. A general surface exchange equation described by Ryan and Stolzenbach (1972) is used in the model. (GRA)

7378 (PB—239227) **Spring and fall thermal bar development in Lake Superior. Completion report.** Hubbard, D.W.; Spain, J.D. (Michigan State Univ., East Lansing (USA). Inst. of Water Research). Dec 1974. Contract DI-14-31-0001-4022. 22p. NTIS $3.25.

The thermal bar is a downwelling phenomenon which occurs parallel to the shore during the spring warming and the fall cooling of large temperature zone lakes. The thermal bar is of practical interest because it traps pollutants in the near-shore zone during certain seasons of the year. The fine structure of the Lake Superior thermal bar was studied during the spring and fall of 1974 with approximately 16 transects being made across the bar using a digital thermistor thermometer capable of 0.01°C accuracy in the vicinity of 4°C. Data were plotted by computer using the SYMAP program. Natural fluorescence arising from land runoff was employed to distinguish between inshore and offshore water masses. (GRA)

7379 (SRO—757-5) **Effects of heated effluents on the reproduction of selected species of the Centrarchid family. Progress report, October 26, 1975—October 25, 1976.** Clugston, J.P.; Provost, E.E. (Georgia Univ., Athens (USA). School of Forest Resources). 1975. Contract AT(38-1)-757. 9p. Dep. NTIS $4.50.

Progress is reported on the effects of thermal effluents on the development of gametes in the bluegill, Lepomis macrochirus; on uptake of the trace metal contaminants, Cd, Cr, and Pb by fishes; on food habits of the bluegill and the largemouth bass, Microptems salmoides; on the distribution of fishes in cooling reservoirs; and on the behavior of the largemouth bass. (HLW)

7380 Environmental impact of a suitable nuclear power reactor used to provide a process heat system to synthesize fuels. Richardson, J.A. (Burns and Roe, Inc., Oradell, NJ). pp 1137-1156 of In Hydrogen energy. Part B. Veziroglu, T.N. (ed.). New York; Plenum Publishing Corp. (1975).

From Hydrogen economy Miami energy conference; Miami Beach, Florida, USA (18 Mar 1974).

See CONF-740306—PB.

The environmental impact of an 1100-MWE light water nuclear power reactor used to provide a process heat system to synthesize fuels is evaluated covering thermal pollution, visual pollution, and radioactive water quantities produced and released to the environment. (auth)

BIOMEDICAL SCIENCES, BASIC STUDIES

7381 (ERDA—110(Vol.1)) **Federal inventory of energy related biomedical and environmental research for FY 1974 and FY 1975.** (Energy Research and Development Administration, Washington, D.C. (USA)). Oct 1975. 91p. Dep. NTIS $5.45.

The Federal agencies considered in the analysis reported approximately $269 million in energy-related biomedical and environmental research in FY 1975. The total national funding of biomedical and environmental research in support of energy technology development in FY 1975 may have exceeded $300 million. Comparing the FY 1975 biomedical and environmental research funding with that of FY 1974 shows a 100 per cent increase in expenditure: FY 1975 funding was $269 million compared with $134 million in FY 1974. A significant fraction of this increase (58 per cent) was due to the $78.5 million energy supplement. Of this supplement, $53.0 million was in EPA "pass through" allocations and the remainder was in direct allocations to ERDA/AEC and NSF. In the various research categories, the most pronounced increase was in Integrated Assessment, increasing from $5.4 million in FY 1974 to $31.7 million in FY 1975. This greatly increased funding was applied to all energy technologies except nuclear which received only a small increase in funding. ERDA/Division of Biomedical and Environmental Research expenditures in FY 1975 accounted for 48 per cent of the total reported funding; consequently, the ERDA distribution of these funds in the research categories and by energy technologies has a profound effect on the national picture. In the various research categories, 42 per cent of reported Federal funding was in Health Effects. (auth)

BEHAVIORAL BIOLOGY

7382 (AECD/TP—34) **Mathematical model for population growth and its control in Bangladesh.** Chowdhury, S.M.M.R. (Atomic Energy Centre, Dacca (Bangladesh)). May 1975. 13p. Dep. NTIS (US Sales Only) $4.50.

A mathematical model which fits the present population growth of Bangladesh has been found and the predicted reduction of total population (in numbers) every five years by means of family planning only is given in the text together with predicted reduction rate of growth. (auth)

7383 Eye-tracking dysfunctions in schizophrenic patients and their relatives. Holzman, P.S.; Proctor, L.R.; Levy, D.L.; Yasillo, N.J.; Meltzer, H.Y.; Hurt, S.W. (Univ. of Chicago). *Arch. Gen. Psychiatr.;* **31**: 143-151(Aug 1974).

A simple test of smooth-pursuit eye movements disclosed a striking association between deviant eye tracking and clinically diagnosed schizophrenia. A high proportion of the schizophrenic patients' first-degree relatives who were not themselves clinically schizophrenic also showed deviant eye-tracking behavior. The relationship of poor eye tracking and schizophrenia is even stronger when specific psychological test evidence of thought disorder is used operationally to classify patients. The eye-tracking dysfunction may thus represent a genetic marker that can prove highly useful for studying the transmission of a vulnerability to schizophrenia. The findings suggest proprioceptive and interoceptive involvement in schizophrenic pathology. (auth)

7384 Behavioral components of dispersal in Drosophila mimica. Richardson, R.H.; Johnston, J.S. (Univ. of Texas, Austin). *Oecologia (Berlin);* **20**: 287-299(1975).

Genetic heterogeneity in Drosophila mimica, a Hawaiian fruit fly, was studied by observing environmental parameters related to dispersion patterns. Behavioral response to wind, light, humidity, and food were measured and interpreted to explain speciation and population dynamics. (JWP)

BIOCHEMISTRY

7385 (BNL—50427) **Processing of RNA. Report of symposium, Upton, New York, May 29—31, 1974.** Dunn, J.J. (ed.). (Brookhaven National Lab., Upton, N.Y. (USA)). 1974. Contract AT(30-1)-16. 366p. (CONF-740594—). Dep. NTIS $10.00.

From Brookhaven symposia in biology; Upton, New York, USA (29 May 1974).

Separate abstracts were prepared for the six sections of the report. (HLW)

7386 (BNL—50427, pp 1-11) **Mutants which allow accumulation of tRNA/sup Tyr/ precursor molecules.** Smith, J.D. (Medical Research Council Laboratory of Molecular Biology, Cambridge, Eng.). 1974.

From Brookhaven symposia in biology; Upton, New York, USA (29 May 1974).

In Processing of RNA.

Studies on transfer RNA included the following mutants which allow accumulation of tRNA/sup Tyr/ precursor molecules; processing of Escherichia coli tRNA/sup Tyr/ precursor in vitro; clustered tRNA genes in E. coli: transcription and processing; tRNA gene clusters in E. coli DNA; inhibition of post-transcriptional modification of E. coli tRNA; and processing of E. coli tRNA precursors. (HLW)

7387 (BNL—50427, pp 77-88) **Bacteriophage T4 tRNAs: structure, genetics, and biosynthesis.** Abelson, J.; Fukada, K.; Johnson, P. (Univ. of California at San Diego, La Jolla). 1974.

From Brookhaven symposia in biology; Upton, New York, USA (29 May 1974).

In Processing of RNA.

Studies on transfer RNA included the following: bacteriophage T4 tRNAs; structure, genetics, and biosynthesis; temperature-sensitive mutants of Escherichia coli defective in tRNA biosynthesis; the biology of bacteriophage T4 transfer RNAs; synthesis of the CCA terminus of transfer RNA; processing of tRNA precursors in higher organisms; biosynthesis of tRNA in the posterior silk gland of Bombyx mori; and acceleration of LRNA renaturation by nucleic acid unwinding proteins. (HLW)

7388 (BNL—50427, pp 175-193) **Primary processing of high molecular weight preribosomal RNA in Escherichia coli and HeLa cells.** Nikolaev, N.; Birge, C.H.; Gotoh, S.; Glazier, K.; Schlessinger, D. (Washington Univ. School of Medicine, St. Louis). 1974.

From Brookhaven symposia in biology; Upton, New York, USA (29 May 1974).

In Processing of RNA.

Studies on ribosomal RNA included the following: primary processing of high molecular weight preribosomal RNA in Escherichia coli and HeLa cells; post-transcriptional modification of nucleotides in E. coli ribosomal RNAs; enzymological aspects of processing of mammalian rRNA; structure and processing of ribosomal RNA: a comparative electron microscopic study in HeLa cells, L cells, and cells of xenopus laevis; and in vitro maturation of precursors of 5S ribosomal RNA from Bacillus subtilis. (HLW)

7389 (BNL—50427, pp 240-266) **RNA processing and the control of gene expression.** Robertson, H.D.; Dickson, E. (Rockefeller Univ., New York). 1974.

From Brookhaven symposia in biology; Upton, New York, USA (29 May 1974).

In Processing of RNA.

RNA processing enzymes are reviewed under the following headings: survey; RNase P; and Escherichia coli RNase III and sizing factor. RNA processing and genetic control are reviewed with regard to possible roles of RNA processing; the role of RNA fragments in models of gene control; and a novel role for RNA fragments. Consequences of primed transcription mediated by specific RNA processing are reviewed under the headings: Stoichiometry; extent of primer-initiated transcription; limitations; economy; studies on HnRNA and eukaryotic mRNA precursors; repetitive nature of DNA regions encoding primers; possible structures for determining priming sites; genetics of primed transcription units; and involvement of RNA processing in control at levels other than transcription. Suggestions are given for experimental approaches. (HLW)

7390 (BNL—50427, pp 267-276) **Processing, transcription, and translation of bacteriophage T7 messenger RNAs.** Dunn, J.J.; Studier, F.W. (Brookhaven National Lab., Upton, NY). 1974.

From Brookhaven symposia in biology; Upton, New York, USA (29 May 1974).

In Processing of RNA.

Studies on messenger RNA included the following: processing, transcription, and translation of bacteriophage T7 messenger RNAs; the specificity of RNAse III cleavage of bacteriophage T7 early messenger RNAs; the fate of mRNA and rRNA in Escherichia coli; and synthesis of mRNA in the cellular slime mold Dictyostelium discoideum. (HLW)

7391 (BNL—50427, pp 320-332) **Effect of estrogen on the synthesis and processing of ovalbumin messenger RNA in the chick oviduct.** Rosen, J.M.; Chan, L.; Woo, S.L.C.; Harris, S.E.; Means, A.R.; O'Malley, B.W. (Baylor College of Medicine, Houston, TX). 1974.

From Brookhaven symposia in biology; Upton, New York, USA (29 May 1974).

In Processing of RNA.

Studies on messenger RNA included the following: processing of HnRNA and its relationship to mRNA in HeLa cells; effect of estrogen on the synthesis and processing of ovalbumin messenger RNA in the chick oviduct; and mapping of viral-specific RNA in the cytoplasm and nucleus of adenovirus 2-infected human cells. (HLW)

7392 (CONF-750745—2) **Activation of nitrite.** Lijinsky, W. (Oak Ridge National Lab., Tenn. (USA)). 1975. 9p. Dep. NTIS $4.50.

From Satellite of IUPHAR congress; Turku, Finland (25 Jul 1975).

At low doses dietary nitrite has no obvious deleterious effect, even when ingested for long periods, and nitrites have been used for a long time as flavoring and coloring additives to meat and fish and as preservatives in food in which there is a danger of botulism. In recent years there has been increasing concern that one form of activation of nitrite might be related to cancer. That is the property of interaction with amino compounds to form N-nitroso compounds, which are potent chemical carcinogens. Results are reported from studies on the carcinogenic effects of nitrite and amines in rats. (CH)

7393 (JUL-Conf—13, pp 131-145) **Optical activity and the origin of life.** Ponnamperuma, C. (Univ. of Maryland, College Park). Nov 1974.

From International symposium on generation and amplification of asymmetry in chemical systems; Julich, F.R. Germany (24 Sep 1973).

In International symposium on generation and amplification of asymmetry in chemical systems.

The role of optical activity in the origin of life is discussed. Analyses of meteorites and lunar samples to aid in these studies are reviewed. (LK)

7394 (JUL-Conf—13, pp 177-197) **Origin of molecular asymmetry through the amplification of "Stochastic Information" (noise) in bioids, open systems which can exist in several steady states.** Decker, P. (Veterinary School, Hanover). Nov 1974.

From International symposium on generation and amplification of asymmetry in chemical systems; Julich, F.R. Germany (24 Sep 1973).

In International symposium on generation and amplification of asymmetry in chemical systems.

Bioids are the simplest chemical open systems capable of "Darwinian" evolution by mutation from one steady state into a more stable one. In the case of exactly equal fitness as with a racemic or a prochiral substrate and with stereospecific autocatalysts, the addition of an "aggressive" reaction (i.e., a reciprocal inhibition of the autocatalysts), causes the spontaneous generation of asymmetric products through bistability. This also can occur in nonaggressive systems with "hypercompetitive" (i.e. more than 2nd order competitive kinetics). Such systems can exist in up to 7 steady states depending on several threshold values. They could be realizable by stereospecific catalysis on two dentated ligands in an octahedral coordination sphere. In a new type of kinetics, where in a complex $MeA_1A_2A_2$ or $MeA_1A_1A_2$ with a racemic substrate, A_1,A_2, a preferential reactivity of the odd ligand may cause resolution by bistability. Evolution in bioids involves acquisition and amplification of different kinds of information, depending on the physical nature of its channel. Autocatalysis requires a molecule which does not always arise spontaneously but can survive and spread as a "material channel" independent of energy supply. In contrast, dissipativestructures like kinetic asymmetry arise spontaneously as acausal macroscopic quantum events but vanish through relaxation without energy supply. Useful general theorems follow from a representation of bioids as a topology on the set of systems of differential equations. (auth)

7395 (JUL-Conf—13, pp 289-380) **Nonlinear mathematical models for the origin of asymmetry in biological molecules.** Hochstim, A.R. (Wayne State Univ., Detroit). Nov 1974.

From International symposium on generation and amplification of asymmetry in chemical systems; Julich, F.R. Germany (24 Sep 1973).

In International symposium on generation and amplification of asymmetry in chemical systems.

The origin of chemical chirality is probably associated with a difference in the initial concentrations of two separate populations of primeval organic molecules and primeval organisms and amplified by nonlinear kinetic processes leading to the death of one population. This theory was originally developed by Frank of the University of Bristol and is reviewed here with additional derivations, discussions and generalizations. (auth)

7396 (JUL-Conf—13, pp 401-420) **Origin of molecular "handedness"** (Stanford Univ., CA). Nov 1974.

From International symposium on generation and amplification of asymmetry in chemical systems; Julich, F.R. Germany (24 Sep 1973).

In International symposium on generation and amplification of asymmetry in chemical systems.

The question of what type of handed environmental bias could have affected the origin of life is considered. (LK)

7397 **Dark repair in bacteriophage systems: overview.** Friedberg, E.C. (Stanford Univ., CA). pp 125-133 of In Molecular mechanisms for repair of DNA. Part A. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974).

See CONF-740231—PA.

Studies on dark repair of DNA in bacteriophages T4 and lambda are reviewed. Some topics discussed are: uv sensitivity of phage mutants; effects of endonuclease on uv-irradiated phage DNA; pyrimidine dimers as substrate sites for endonuclease in DNA; electron microscopic studies of enzyme-treated uv-irradiated DNA; role of phage T4 genes in DNA repair; and host-cell reactivation, prophage reactivation, and uv reactivation in phase lambda. (HLW)

7398 **Procedure for the rapid lysis of mammalian cells prior to alkaline sucrose density gradient centrifugation.** Walters, R.A.; Hildebrand, C.E. (Los Alamos Scientific Lab., NM). *Biochim. Biophys. Acta;* **407**: 120-124(1975).

Relatively long exposures to alkaline conditions are required to effect lysis and DNA strand separation in some cell lines prior to alkaline sucrose gradient centrifugation. We describe here a simple technique utilizing sodium lauroyl sarcosine and heparin which permits a reduction in alkaline lytic storage time of from 5-6 h to 45 min for Chinese hamster cells layered onto a gradient. (auth)

7399 **Exciton transfer in DNA.** Shapiro, S.L.; Campillo, A.J.; Kollman, V.H.; Goad, W.B. (Los Alamos Scientific Lab., NM). *Opt. Commun.;* **15**: No. 2, 308-310(Oct 1975).

Fluorescent risetimes are measured to be less than 20 ps for DNA - acridine orange complexes. This result is consistent with a rapid non-radiative depletion of the excited singlet state of DNA due to exciton - phonon interactions. (auth)

7400 **Computer interfaced dual-beam rapid scan stopped-flow system for the study of transients in enzyme reactions.** Suelter, C.H.; Coolen, R.B.; Papadakis, N.; Dye, J.L. (Michigan State Univ., East Lansing). *Anal. Biochem.;* **69**: No. 1, 155-163(Nov 1975).

An existing rapid scan stopped-flow apparatus was modified and interfaced to a PDP-8/I Computer to permit study of changes in the spectra of substrates, transient intermediates, and products of enzyme-catalyzed reactions. The data-acquisition software produces significant real time signal-to-noise enhancement and greatly reduced data storage requirements. The reaction of p-nitroso-N,N-dimethyl aniline and NADH catalyzed by horse liver alcohol dehydrogenase was observed by scanning from 300 to 540 nm. It was possible from observation of a single reaction mixture to confirm previous reports [Dunn and Bernhard, Biochemistry 10, 4569 (1971); Schack and Dunn, Abstracts 8th Meeting, Fed. Eur. Biochem. Soc. No. 303 (1972)] of two intermediates and to suggest yet a third in the process. (auth)

7401 **Assay of picomole amounts of ATP, ADP, and AMP using the luciferase enzyme system.** Kimmich, G.A.; Randles, J.; Brand, J.S. (Univ. of Rochester, NY). *Anal. Biochem.;* **69**: No. 1, 187-206(Nov 1975).

Procedural modifications of the luciferase method for ATP assay in conjunction with enzymatic conversion of AMP and ADP allow the assay of all three adenine nucleotides in quantities ranging from 4 to 20 pmoles. An unmodified Beckman scintillation detector at ambient temperature and in a coincidence mode of operation serves as a suitable instrument for quantitating light emitted by the enzyme preparation. The most significant modifications include use of $Ca_3(PO_4)$ activated crude arsenate extracts of desiccated firefly lanterns, low arsenate concentrations during the assay, and an assay pH of 8.0. Extracts handled in this manner exhibit approximately fivefold higher activity than nonactivated extracts employed at pH 7.4 and 50 mm arsenate. Stability of activated extracts is also somewhat greater than for nonactivated preparations. ADP can be 95% enzymatically converted to ATP by treatment with phosphoenolypyruvate and pyruvate kinase under the conditions described. If myokinase is included, approximately 90% of sample AMP can be converted to ATP. Following the appropriate enzymatic treatment, the nucleotides are assayed as ATP and amounts calculated by comparison to curves established for known nucleotide standards. The method is appropriate for perchloric acid extracts of biological tissue and certain considerations necessary for application to experimental situations are described. (auth)

TRACER TECHNIQUES

7402 **DNA turnover and strand breaks in Escherichia coli.** Hanawalt, P.; Grivell, A.; Nakayama, H. (Stanford Univ., CA). pp 47-50 of In Molecular mechanisms for repair of DNA. Part A. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974).

See CONF-740231—PA.

The extent of DNA turnover has been measured in a dnaB mutant of Escherichia coli, temperature sensitive for semiconservative DNA replication. At the nonpermissive temperature about 0.02 percent of the deoxynucleotides in DNA are exchanged per generation period. This turnover rate is markedly depressed in the presence of rifampicin. During thymine starvation strand breaks accumulate in the DNA of E. coli strains that are susceptible to thymineless death. Rifampicin suppresses the appearance of these breaks, consistent with our hypothesis that transcription may be accompanied by repairable single-strand breaks in DNA. DNA turnover is enhanced severalfold in strands containing 5-bromodeoxyuridine in place of thymidine, possibly because the analog (or the deoxyuridine, following debromination) is sometimes recognized and excised. (auth)

7403 **Degradation of duplex DNA by the recBC DNase of Escherichia coli.** Linn, S.; MacKay, V. (Univ. of California, Berkeley). pp 293-299 of In Molecular mechanisms for repair of DNA. Part A. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974).

See CONF-740231—PA.

The catalytic reactions of the recBC enzyme of Escherichia coli with various substrates are reviewed, and a model for the sequence of events in the degradation of duplex DNA is presented. The potential of the enzyme to take part in genetic recombination and repair is discussed. (auth)

7404 **Radioactive labeling of α-bungarotoxin with tritium.** Eterovic, V.A.; Aune, R.G.; Bennett, E.L. (Univ. of California, Berkeley). *Anal. Biochem.;* **68**: No. 2, 394-403(Oct 1975).

α-[^{3}H] bungarotoxin (Bgt) was prepared by catalytic reduction of ^{125}I-labeled α-Bgt with tritium. Specific activities of 10 to 15 Ci/mmol were attained. The radioactive label was found in tyrosine. Tritiated α-Bgt appears to bind specifically to the cholinergic receptor of diaphragm and to a similar component of cerebral cortex. This specificity and the high specific radioactivity attained provide a useful tool for the study of acetylcholine receptor in brain and other tissues with low receptor concentration. (auth)

CYTOLOGY

7405 (CONF-751069—1) **Precursor lesions of bronchogenic carcinoma: introductory remarks.** Nettesheim, P. (Oak Ridge National Lab., Tenn. (USA)). 1975. 16p. Dep. NTIS $4.50.

From Conference on early lesions and the development of epithelial cancer; Bethesda, Maryland, USA (21 Oct 1975).

Available criteria that can be used to assign early lesions to a particular stage of the evolutionary process of bronchogenic neoplastic disorders rather than to that of inflammatory or degenerative diseases and information needed to develop new criteria for the identification of early manifestations of neoplastic disorders are discussed. (CH)

7406 (CONF-751076—1) **Population cytogenetics of leukemia.** Rowley, J. (Chicago Univ., Ill. (USA). Dept. of Medicine; Franklin McLean Memorial Research Inst., Chicago, Ill. (USA)). 1975. 39p. Dep. NTIS $5.00.

From 6. symposium on population cytogenetics; Albany, New York, USA (14 Oct 1975).

Chronic myelogenous and acute leukemia are reviewed with regard to data obtained prior to banding of chromosomes, data obtained with banding of chromosomes, and pH-negative patients. Abnormal chromosome patterns of patients are described. Relationships of chromosome abnormalities in acute and chronic myelogenous leukemia are discussed and chromosomal abnormalities in other neoplastic conditions are reviewed. (HLW)

7407 (CONF-751211—1) **Action of cyclic adenosine 3':5'-phosphate in Chinese hamster ovary cells.** Hsie, A.W.; O'Neill, J.P.; Schroeder, C.H.; Kawashima, K.; Borman, L.S.; Li, A.P. (Oak Ridge National Lab., Tenn. (USA)). 1975. 30p. Dep. NTIS $5.00.

From Symposium on modified cellular and molecular controls in neoplasia; Honolulu, Hawaii, USA (9 Dec 1975).

The epithelial-shaped CHO cells growing randomly in vitro in a compact, multilayered colony convert into a contact-inhibited monolayer of elongated, fibroblast-like cells when treated with Bt_2cAMP (or purified cholera toxin). The morphological conversion is also accompanied by the disappearance of cell surface knobs, decrease in cellular agglutinability, an increase in the number of microtubules and their arrangement in parallel arrays along the long axis of the cell, and induction of collagen synthesis. Continuous exposure of CHO cells to Bt_2cAMP had at most only minor effects on progression through the cell cycle. Only cells in the G_1 phase of the cycle initiate elongation when incubated with Bt_2cAMP. Hormones such as testosterone and prostaglandins exert the morphological effects synergistically with Bt_2cAMP. Although the mechanisms of morphological transformation and its associated reversal of certain properties associated with malignancy of CHO cells in vitroare as yet obscure, it is clear, however, that a fundamental change in membrane properties is involved. Such a change may result in altered cellular permeability to essential nutrients, which in turn may regulate growth and differentiation. Experiments with mammalian cells derived from mouse embryo, mouse neuroblastoma, and rat hepatoma have shown that cAMP and/or its dibutyryl derivatives also alter the morphology and growth rate of those cells. Thus it is possible that cAMP alone or in combination with certain hormones has a central role in regulating the morphology and growth of all mammalian cells. Finally, variants with altered properties of morphological transformation have been isolated, and it is expected that genetic analyses and biochemical characterizations of these variants and their parental cells will aid in the elucidation of the molecular mechanisms involved in the morphological and its associated characteristics. (auth)

7408 (LA—6144-PR) **Automated cancer-cell sorting and analysis. Progress report, April 1—September 30, 1975.** Ingram, M.; Crissman, H.A.; Crowell, J.M.; Hansen, K.M.; Martin, J.C.; Salzman, G.C.; Steinkamp, J.A.; Svitra, Z.V. (Los Alamos Scientific Lab., N.Mex. (USA)). Nov 1975. Contract W-7405-ENG-48. 11p. Dep. NTIS $4.00.

The various LASL flow-system instruments for rapid cell analysis are being applied to identification and analysis of malignant and pre-malignant cells for cancer screening and diagnosis. Progress during the period April 1 through September 30, 1975, is summarized briefly. Major activities have been procurement, preparation, and analysis of gynecological specimens (exfoliated cells from the vagina and uterine cervix); verification of instrument results; and instrument development, including the flow microfluorometer with time-amplitude conversion capability, the multiparameter sorter II, and the multiangle light-scatter system. The anticipated work plan is also summarized briefly. (auth)

7409 (UCRL—77458) **Pulse cytometric analysis of the perturbed cellular kinetics of solid tumors: problems and promises.** Dethlefsen, L.A.; Gray, J.W.; George, Y.S.; Johnson, S. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 3 Nov 1975. Contract W-7405-Eng-48. 28p. (CONF-750957—4). Dep. NTIS $4.00.

From 2. international symposium on pulse cytophotometry; Munster, F.R. Germany (17 Sep 1975).

Pulse cytometric measurements of the cellular DNA content distributions have been made on cells from normal and hydroxyurea-perturbed mammary tumors from two in vivo lines (Slow and S102F) of the C3H mouse. The tumor cells were dissociated mechanically and stained for DNA according to an acriflavine-Feulgen technique. A comparison of autoradiographic data from the tumor sections and single cell suspensions following pulse labeling with ^{3}H-TdR showed that the dissociation technique is not biased against cells from any of the various phases of the cell cycle; however the mitotic cells are difficult to recognize morphologically. The fluorescence distributions from the DNA stained cells showed a peak corresponding to noncycling diploid cells and at a higher fluorescence, a classical distribution of cycling tumor cells which are near-tetraploid in DNA content. These features are superimposed on a continuum of fluorescence from stained cellular and nuclear fragments. The changes in the DNA distributions produced by perturbing the tumors with hydroxyurea are compared through mathematical modeling to those expected from kinetic data obtained by the more classical methodology of ^{3}H-TdR pulse labeling and autoradiography. Both the flow microfluorometric and autoradiographic data show that a single injection of hydroxyurea affects a sizable fraction of the S102F tumor cells. The effects on the Slow tumor cells are not as readily apparent. (auth)

7410 (UCRL—77665) **Corticosteroid effect on the cell cycle.** Gehring, U.; Gray, J.W.; Tomkins, G.M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 9 Jan 1976. 15p. (CONF-750957—5). Dep. NTIS $3.50.

From 2. international symposium on pulse cytophotometry; Munster, F.R. Germany (17 Sep 1975).

The steroid induced inhibition of cell proliferation which precedes cell death suggests that the cells held up in G_1 phase by the growth inhibitory effect of the steroid are those cells which are most susceptible to the killing effect of the steroid. This notion is supported by the observation that cells arrested in G_1 by treatment with dibutyryl cyclic AMP are killed by the steroid without the lag which is seen with randomly growing cells. These data suggest either of two hypothesis concerning the effect of dexamethasone on S49 lymphoma cells: the transit time through the G_1 phase is lengthened and that cells in the G_1 phase are preferentially killed; some of the cells in G_1 enter an arrested state from which cell death occurs. Further experiments are necessary to distinguish between these two hypotheses. (auth)

7411 (LF-tr—102) **Evaluation of total alveolar macrophage population in rats.** Sedaghat, B.; Masse, R.; Nenot, J.C.; Lafuma, J.; Martin, J.C. Translated from *C. R. Hebd. Seances Acad. Sci., Ser. D;* **273**: 229-232(12 Jul 1971). 11p. Dep. NTIS $3.50.

The use of an appropriate tracing technique with hematite particles activated by neutron irradiation allows evaluating the total alveolar macrophage population in the lungs. The results show that the number of macrophage thus estimted appears to be twice as great as that obtained by the conventional methods of lung washing. (auth)

7412 (UCRL-Trans—10670) **Cytofluorimetric study of the DNA content in gastric cancer cells.** Matyushina, E.D.; Rapoport, S.I.; Zelenin, A.V. Translated from *Vopr. Onkol.;* **19**: No. 8, 8-13(1973). 10p. Dep. NTIS $3.50.

By means of cytofluorimetry the DNA content in 7102 cell nuclei, obtained from 33 human gastric tumors, has been studied. There was found a considerable increase in the DNA content in cancer cells in comparison with the normal (diploid) amount. No correlation between the cell distribution in relation to the DNA content in nuclei and different histological types of cancer was observed. A tendency toward the enhanced ploidity of cells as tumor penetrates the gastric wall is noted. (auth)

7413 (UCRL-Trans—10917) **Methods of chromosome investigation in the gametogenesis and embryogenesis of mammals.** Dyban, A.P.; Baranov, V.S. Translated from *Arkh. Anat., Gistol. Embriol.;* **66**: No. 1, 79-89(1974). 21p. Dep. NTIS $4.50.

The importance of chromosome studies during successive stages of embryogenesis for understanding the genetic mechanisms of individual development is emphasized. Methods are given for chromosome analysis in all stages of male and female gametogenesis and successive stages of embryogenesis beginning with cleavage and ending with the fetal period. Methods are described under the following headings: methods for chromosomal preparations from male sex glands; chromosome preparations of female gametes; investigation of mammal embryo chromosomes in the initial stages of development; metaphase analysis during neuralation and initial organogenesis; metaphase analysis at the time of later organogenesis; and metaphase analysis at the end of the fetal period. (HLW)

GENETICS

7414 **T-alleles in the mouse are probably not inversion.** Womack, J.E.; Roderick, T.H. (Jackson Lab., Bar Harbor, ME). *J. Hered.;* **65**: 308-310(1974).

Animals heterozygous for the t^6 allele are known to exhibit reduced crossing over in the region near the allele. Testes of t^6/+ males, however, showed first meiotic anaphase bridge frequencies

that were not significantly different from those frequencies in T/+ or +/+ animals, nor from frequencies observed in other animals with normal chromosomal arrangements. Two other possible characteristics of inversions, frequencies of broken bridges at anaphase I and frequencies of fragments appearing alone at anaphase I, also were not significantly different between the genotypes. These data indicate that an inversion involving most of the region between T and H-2 is not a likely explanation for the suppression of crossing-over in that region attributable to the t^6 allele. (auth)

7415 Esterase-6 (Es-6) in laboratory mice: hormone-influenced expression and linkage relationship to oligosyndactylism (Os), Esterase-1 (Es-1), and Esterase-2 (Es-2) in chromosome 8. Womack, J.E. (Jackson Lab., Bar Harbor, ME). *Biochem. Genet.*; 13: No. 5/6, 311-322(1975).

Allelic differences at an esterase locus designated Es-6 exist between mouse strain C57BL/6J and a laboratory stock of Mus musculus molossinus. Strain C57BL/6J has been assigned the allele Es-6/sup a/ and Mus musculus molossinus the alternate allele ES-6/sup b/. Kidney expression of the electrophoretic esterase band controlled by the Es-6 locus is sex influenced, with increased activity apparently induced by testosterone. A four-point test cross established the gene order Os—Es-1—Es-6—Es-2 within a 10-cM segment on chromosome 8. (auth)

7416 Regulatory mutants and control of cysteine biosynthetic enzymes in Salmonella typhimurium. Borum, P.R.; Monty, K.J. (Univ. of Tennessee, Knoxville). *J. Bacteriol.*; 125: No. 1, 94-101(Jan 1976).

The cysB region in Salmonella typhimurium regulates in a positive manner the noncontiguous structural genes for the enzymes responsible for sulfate reduction in cysteine biosynthesis. We treated three cysB mutants with chemical mutagens and selected 81 secondary mutants in which the inability to utilize sulfate was suppressed. Growth experiments on the suppressed mutants showed that the original loss of sulfate utilization had been corrected to varying degrees and that portions of the pathway had been established in abnormal relationships to one another. Sixty of the suppressed mutations were mapped via transductional analysis, and each was very closely linked to the original cysB mutation. We demonstrated that the cysB product functions in the regulation of the cysteine biosynthetic enzymes during both logarithmic growth and stationary phase. Mutation can alter the regulatory response of one enzyme in either an upward or downward direction while the regulation of other enzymes in the pathway remains unchanged. These data are consistent with the idea of a multivalent or multisite regulator molecule. (auth)

7417 Mismatch correction in pneumococcal transformation: donor length and hex-dependent marker efficiency. Guild, W.R.; Shoemaker, N.B. (Duke Univ., Durham, NC). *J. Bacteriol.*; 125: No. 1, 125-135(Jan 1976).

A hypothesis that preferential rejection of donor markers by the hex system of pneumococcus is due to lethal double-strand breaks has been examined in terms of its implications for the extent of the excision required. Experiments reported here were directed at asking whether hex-dependent marker efficiency depends on the length of the donor deoxyribonucleic acid (DNA). In the absence of intracellular competition for hex function, there was no detectable effect of DNA size on hex-dependent marker efficiency as donor DNA was sheared from greater than 1×10^7 daltons to 3.6×10^6 daltons. The latter DNA was purified by two successive velocity fractionations to ensure that the activity seen was representative of DNA of that size. Quantitative examination of the system shows that, for the lethal event hypothesis to be true, the excision step has to remove an average of 7,000 to 10,000 nucleotides. This figure is so much greater than that seen in other excision processes that alternate hypotheses should be considered. The presently known properties of the hex system can be accounted for by a model invoking the migratory features of type I restriction enzymes. (auth)

METABOLISM

7418 (AE—508) **Statistic performance of dichromatic scanners for absorptiometric determination of bone mineral content using low energy gamma rays.** Dissing, E. (Aktiebolaget Atomenergi, Studsvik (Sweden)). Dec 1975. 15p. Dep. NTIS (US Sales Only) $3.50.

The determination of bone mineral content in vivo by means of gamma ray absorptiometry presupposes good statistics concerning the nuclear random counting process. In principle, therefore, the isotope source should be made as strong as possible. However, practical difficulties in the achievement of a high specific isotope concentration, concern about dose to the patient, electronic problems associated with high count rates, and economic considerations all set rather definite limits to the use of higher source strength for solving the problem of statistics. The calculations are demonstrated with a very well known system using I-125 and Am-241 for the determination of the bone mineral content of the human arm. The relative standard deviations to be expected for different source strengths and for different geometries considering bone mineral content and soft tissue contribution are calculated. (auth)

7419 (BNL—20771) **Validity of the absorptrometric measurement of bone mineral content of the radius.** Cohn, S.H.; Ellis, K.J.; Goldsmith, N.F. (Brookhaven National Lab., Upton, N.Y. (USA)). [nd]. 12p. Dep. NTIS $3.50.

The technique of photon absorptiometry, as described by Cameron and others (1-4), is used to obtain a measure of bone density. This measure, based on data derived from the transmission scan of ^{125}I, clearly relates to the degree of mineralization of the bone, and hence is termed bone mineral content (BMC). Although BMC is a measure of linear density made at a particular site on one bone in the appendicular skeleton, BMC values are widely interpreted to be a measure of whole body Ca, with the implicit assumptions that osseous tissue is essentially homogeneous throughout the skeletal system; all osseous tissue reacts in the same way to influences such as dietary changes, drugs, and disease; and density is directly proportional to Ca. On the basis of these often unexpressed assumptions, many investigators have used BMC data to derive a value for the absolute measure of radial bone mineral and by extrapolation, a measure of absolute total-body calcium. The validity of the standard normalization procedure for the BMC measurement were investigated by comparing the results obtained with those derived from absolute measurements of total-body calcium normalized for three parameters listed. (CH)

7420 (COO—3140-34) **Toxicology and metabolism of nickel compounds. Progress report, December 1, 1974—November 30, 1975.** Sunderman, F.W. Jr. (Connecticut Univ., Farmington (USA). School of Medicine). 15 Aug 1975. Contract E(11-1)-3140. 32p. Dep. NTIS $5.00.

The toxicology and metabolism of nickel compounds ($NiCl_2$, Ni_3S_2, NiS, and Ni powder) were investigated in rats and hamsters. The new knowledge has included: demonstration that hyperglucagonemia is primarily responsible for the acute hyperglycemic effect of parenteral Ni(II) in rats; demonstration that parenteral injection of Ni(II) in rats produces acute nephropathy with proteinuria and amino aciduria, and with ultrastructural lesions of renal glomeruli and tubules; confirmation of the inhibitory effect of manganese upon the carcinogenicity of Ni_3S_2 after intramuscular injection in rats, and elucidation of the effects of manganese upon the rates of excretion of nickel, and upon the acute histological reactions produced by Ni_3S_2; discovery that the antidotal efficacy of triethylenetetramine (TETA) in acute Ni(II) poisoning in rats is substantially greater than that of other chelating agents, including α-lipoic acid, diethyldithiocarbamate, d-penicillamine, and glycyl-glycyl-L-histidine-N-methylamide; observation that the acute renal toxicity of Ni(II) is suppressed by administration of TETA, but that the hyperglycemic and hyperglucagonemic responses to Ni(II) are not prevented by TETA; confirmation that marked erythrocytosis is induced in rats by a single intrarenal injection of Ni_3S_2, and elucidation of the time-response and dose-response relationships for the Ni-induced erythrocytosis. (auth)

7421 (IFA-SR—12-1975) **Influence of the pH of the tissues on the transverse relaxation time T_2.** Kiricuta, I.C.; Demco, D.; Simplaceanu, V. (Institutul de Fizica Atomica, Bucharest (Romania)). 1975. 5p. (CONF-740125—2). Dep. NTIS (US Sales Only) $3.50.

From Meeting of International Society of Magnetic Resonance; Bombay, India (Jan 1974).

Spin-echo nuclear magnetic resonance measurements may be used as a method for studying the influence of pH upon T_2. The transverse relaxation time T_2 was measured on Ehrlich ascites and Ehrlich solid tumors. An increase of T_2 with 184 ms in the case of Ehrlich ascites and 16 ms for Ehrlich solid tumor could be observed when the pH values decrease. The data are in accordance with a model that explains the change of T_2 with the tetanic isometric contraction. (auth)

7422 Control of tissue manganese: initial absence and sudden emergence of excretion in the neonatal mouse. Miller, S.T.; Cotzias, G.C.; Evert, H.A. (Brookhaven National Lab., Upton, NY). *Am. J. Physiol.*; 229: No. 4, 1080-1084(Oct 1975).

All adult animals and humans tested up to this time have controlled their tissue manganese concentrations by controlling primarily the rate of the metal's excretion. In sharp contrast, neonatal mice did not excrete manganese for the first 17 to 18

days of life, although absorption of the natural ^{55}Mn as well as distribution, tissue accumulation, and mitochondrial accumulation of the radioactive ^{54}Mn were vigorous. This suggested an initially avid accumulation of this essential micronutrient, supplied in scarce traces in mouse milk (54 ng/ml) by mothers consuming very much higher dietary concentrations (55,000 ng/g). The tissue accumulation was demonstrated analytically and was particularly impressive in the brain, which can be susceptible to both manganese poisoning and deficiency. (auth)

TRACER TECHNIQUES

7423 Iodine absorption, excretion, recycling, and tissue distribution in the dairy cow. Miller, J.K.; Swanson, E.W.; Spalding, G.E. (Comparative Animal Research Lab., Oak Ridge, TN). *J. Dairy Sci.*; **58**: No. 10, 1578-1593(Oct 1975).

Research on iodine metabolism was reviewed with special reference to cattle and milk secretion. Iodine metabolism in the fetus and thyroid activity as related to milk secretion and iodine feeding have also been considered. Between 70 and 90 percent of dietary iodine is absorbed directly from the bovine rumen, reticulum, and omasum. In the abomasum, rate of iodide secretion is approximately 18 times the rate of absorption. Circulating thyroxine is not secreted into the abomasum but enters the small intestine in the bile. Most of the iodide secreted into the abomasum is reabsorbed from the small and large intestines; absorption of thyroxine averages less than 10 percent. The thyroid usually contains an amount of iodine equal to the daily dietary intake; extrathyroidal tissues concentrate only .006 to .04 percent as much radioiodine per unit weight as the thyroid. At normal iodine intake (<10 μg/kg body weight daily), iodine losses average 30 percent of the daily intake in feces, 40 percent in urine, and 8 percent in milk. Milk iodine is influenced by amount and chemical form of dietary iodine, stage of lactation or milk yield, seasonal effects, goitrogens, and thyroid status. Cows secrete less iodine into milk than most other species and have an efficient iodine recycling system via the gastrointestinal tract which conserves iodine and can protect them against low dietary iodine. (auth)

MEDICINE

7424 (IRI—133-75-08) Applications of x-ray fluorescense analysis in medicine. de Bruin, M.; Korthoven, P.J.M. (Interuniversitair Reactor Instituut, Delft (Netherlands)). 1975. 16p. Dep. NTIS (US Sales Only) $3.50.

The x-ray fluorescence analysis techniques are described and applications in the determination of trace amounts of elements in biological materials are discussed. It is concluded that useful applications of the technique can both be made in medical research, as well as diagnostic tests in clinical practice. (CH)

7425 (UCRL—50025-75-4, pp 13-17) Reconstructing three-dimensional images from two-dimensional medical x-rays. 8 Oct 1975.

In Electronics Engineering Department quarterly report No. 4, 1975.

Computer reconstruction techniques were developed to produce three-dimensional images from two-dimensional medial x-ray data. Multiple radiographic shadowgraphs, each representing an x-ray density through an object from a different angle, are used to reconstruct three-dimensional images of cross sections through the object being x rayed. These cross-sectional images, then, are recorded and displayed on a television screen, making it possible to produce three-dimensional video pictures of dynamic organs, such as the beating heart. (auth)

7426 (UCRL-Trans—10914) Evaluation of the use of tetracycline antibiotics in the diagnosis of malignant tumors. Malek, P.; Zastava, V.; Kolc, J.; Zak, F. Translated from *Cas. Lek. Cesk.*; **102**: 16-20(1963). 14p. Dep. NTIS $4.50.

On the basis of experimental and clinical findings the time appears propitious to revise current views on the use of TA in the diagnosis of malignant tumors, largely for the following two reasons: TA is not bound to the tumor cell itself but to the stroma at the site of regressive changes, primarily the histiocytes; TA binding is not a unique property of tumors. Many non-neoplastic states exist which bind TA more rapidly and retain it in incomparably higher concentrations (pancreatic necrosis, ischemic tissues, necrosis due to burns, etc.). For practical purposes it appears more promising to utilize TA as a diagnostic tool in the latter type of conditions, e.g., myocardial infarction. (auth)

7427 Managing medical emergencies in malignancy. Stein, R.S.; Ultmann, J.E. (Univ. of Chicago). pp 1-8 of In Hospital physician. Oradell, NJ; Litton Industries, Inc. (1975).

Diagnostic and therapeutic guidelines are given for assessment and palliation of medical complications in patients with malignancies. Special emphasis is placed on recognizing and managing drug toxicity. (JWP)

TRACER TECHNIQUES

7428 (CONF-730687—) Information processing in scintigraphy. Proceedings of the third international conference, Cambridge, Massachusetts, 6—9 June 1973. Metz, C.E.; Pizer, S.M.; Brownell, G.L. (eds.). (Massachusetts Inst. of Tech., Cambridge (USA)). 1973. 215p. Dep. NTIS $7.60.

From 3. international conference on data handling and image processing in scintigraphy; Cambridge, Massachusetts, USA (6 Jun 1973).

Separate abstracts were prepared for the 16 papers. (CH)

7429 (CONF-730687—, pp 1-6) Parameter estimation for dynamic radiotracer studies. Snyder, D.L. (Washington Univ., St. Louis). 1973.

From 3. international conference on data handling and image processing in scintigraphy; Cambridge, Massachusetts, USA (6 Jun 1973).

In Information processing in scintigraphy.

Some on-going investigations of parameter estimation for radiotracer studies are outlined. These investigations are aimed at identifying an efficient computational algorithm for implementing maximum likelihood parameter estimates, at identifying a model which accounts for non-deal effects such as deadtime found in real scintillation detectors, and at identifying a model for including the spatial as well as the temporal aspects of the problem. (auth)

7430 (CONF-730687—, pp 7-27) Parameter estimation in clinical nuclear medicine studies. Brill, A.B.; Price, R.R.; Patton, J.P.; Erickson, J.J.; Ivancevic, D. (Vanderbilt Univ., Nashville). 1973.

From 3. international conference on data handling and image processing in scintigraphy; Cambridge, Massachusetts, USA (6 Jun 1973).

In Information processing in scintigraphy.

The advent of sophisticated computerized data acquisition systems in nuclear medicine has provided a voluminous amount of dynamic scintigraphic data. The problem at hand is the interpretation of these data into meaningful diagnostic information. It is pointed out that there are a number of difficulties one normally encounters in this endeavor and how we and others have chosen to cope with these problems is indicated. We have suggested: the use of multiple views of a radionuclide distribution for improved accuracy of quantitation, the use of simulation modelling analysis for complicated systems, the arbitrary selection of symmetric regions of interest when no a priori reason to select a particular region is available, and the use of potentially powerful statistical tests such as the analysis of variance or factor analysis to detect anomalous regions when on adequate model is available. (auth)

7431 (CONF-730687—, pp 28-61) Mathematical model for in vivo measurement of metabolic rates using externally monitored radiotracers. Larson, K.B.; Raichle, M.E.; Phelps, M.E.; Grubb, R.L. Jr.; Welch, M.J.; Ter-Pogossian, M.M. (Washington Univ., St. Louis, MO). 1973.

From 3. international conference on data handling and image processing in scintigraphy; Cambridge, Massachusetts, USA (6 Jun 1973).

In Information processing in scintigraphy.

A mathematical model was developed for analyzing data from in vivo metabolism studies based on external monitoring of radioisotopes used to label pharmaceuticals injected into the circulation. Our method is atraumatic, depending only on intravenous injection of two radiotracers and on continuous sampling of arterial blood via catheter from a peripheral site. One injection is of labeled substrate; the other, of a labeled nondiffusible vascular tracer. Following each injection, radioactivities in the organ of interest and in sampled arterial blood are monitored by two external radiation detectors. Thus, for each study, four detector response curves are obtained. The purpose of the second injection is to allow unextracted vascular radioactivity, and by difference, tissue radioactivity, to be determined in the organ of interest. The equations of the model show how tissue radioactivity is related to uptake and utilization of unlabeled substrate in the organ. We have developed algorithms based on these equations for processing the four response curves in order to compute the metabolic utilization rate and other parameters of interest. These algorithms can be implemented on a digital minicomputer if so desired. We have validated our model in a particular application by measuring brain glucose metabolism in live rhesus monkeys, noting the agreement between the results of our method and those of an independent (though traumatic) technique. In conclusion, we discuss possible

applications of our model in studies of other metabolic systems. (auth)

7432 (CONF-730687—, pp 64-66) **Method of iterative section separation in tomoscintigraphy.** Schmidlin, P. (German Cancer Research Center, Heidelberg). 1973.

From 3. international conference on data handling and image processing in scintigraphy; Cambridge, Massachusetts, USA (6 Jun 1973).

In Information processing in scintigraphy.

A method of iterative section separation based on the observation of the radiating object from different directions is described. Applications in tomographic scintiscanning using γ or positron cameras are discussed. (CH)

7433 (CONF-730687—, pp 67-79) **Tomography and the reconstruction of images from their projections.** Todd-Pokropek, A. (University College Hospital Medical School, London). 1973.

From 3. international conference on data handling and image processing in scintigraphy; Cambridge, Massachusetts, USA (6 Jun 1973).

In Information processing in scintigraphy.

A series of methods exists to reconstruct section scan data, being either iterative, using a filter, or by using a two-dimensional Fourier transform. It appears that, provided the system has been correctly set up with appropriate sampling intervals and reasonable signal-to-noise, any of these techniques will give good images. The clinical results so far seem to indicate that such a technique as section scanning can be of some value in refining the diagnosis that may be obtained from conventional brain scanning, which it does not in any way replace. Particular help has been obtained when dealing with lesions of the posterior fossa. (auth)

7434 (CONF-730687—, pp 82-92) **Two-stage nonlinear filter for processing of scintigrams.** Pistor, P.; Hoener, J.; Walch, G. (IBM Scientific Center, Heidelberg). 1973.

From 3. international conference on data handling and image processing in scintigraphy; Cambridge, Massachusetts, USA (6 Jun 1973).

In Information processing in scintigraphy.

Linear filters which have been successfully used to process scintigrams can be modified in a meaningful manner by a preceding non-linear point operator, the Anscombe-transform. The advantages are: The scintigraphic noise becomes quasi-stationary and thus independent of the image. By these means the noise can be readily allowed for in the design of the convolutional operators. Transformed images with a stationary signal-to-noise ratio and a non-constant background t correspond to untransformed images with a signal-to-noise ratio that varies in certain limits. The filter chain automatically adapts to these changes. Our filter has the advantage over the majority of space-varying filters of being realizable by Fast Fourier Transform techniques. These advantages have to be paid for by reduced signal amplitude to background ratios. If the background is known, this shortcoming can be easily by-passed by processing trendfree scintigrams. If not, the filter chain should be completed by a third operator which reverses the Anscombe-transform. The Anscombe-transform influences the signal-to-noise ratio of cold spots and of hot spots in a different way. It remains an open question if this fact can be utilized to directly influence the detectability of the different kinds of spots. (auth)

7435 (CONF-730687—, pp 93-101) **Results of nonlinear and nonstationary image processing.** Pizer, S.M. (Univ. of North Carolina, Chapel Hill); Correla, J.A.; Chesler, D.A.; Metz, C.E. 1973.

From 3. international conference on data handling and image processing in scintigraphy; Cambridge, Massachusetts, USA (6 Jun 1973).

In Information processing in scintigraphy.

A nonstationary method, multiple z-divided filtering, and a nonlinear method, biased smearing have been applied to scintigrams. Biased smearing does not appear to hold much promise. Multiple z-divided filtering, on the other hand, appears to be justified, and initial results at minimum encourage further research into the possibility that this technique may become a method of choice. (auth)

7436 (CONF-730687—, pp 102-114) **Nonlinear frequency domain techniques for enhancement of radionuclide images.** Kirch, D.L.; Brown, D.W. (Denver Veterans Administration Hospital). 1973.

From 3. international conference on data handling and image processing in scintigraphy; Cambridge, Massachusetts, USA (6 Jun 1973).

In Information processing in scintigraphy.

A digital filtering technique for resolution enhancement of radionuclide images is described, which is termed adaptive enhancement. This is a nonlinear frequency domain approach which seeks to optimize the smoothing function applied to image data based on knowledge of the image power spectrum alone. This approach has been motivated by the difficulties experienced in attempting to find a linear smoothing filter which works well for the entire class of radionuclide images being processed. A method for performing spectral extrapolation is then applied. A departure from inverse MTF enhancement filters is also described. (auth)

7437 (CONF-730687—, pp 115-124) **Improvement of gamma camera data processing due to sequential acquisition.** DiPaola, R.; Bazin, J.P.; DiPaola, M. (Institut Gustave-Roussy, Villejuif, France). 1973.

From 3. international conference on data handling and image processing in scintigraphy; Cambridge, Massachusetts, USA (6 Jun 1973).

In Information processing in scintigraphy.

The advantages of sequential radionuclide scan data acquisition compared to incremental collection for gamma camera events have become increasingly apparent. Computerized systems allow one to choose the mode of data collection, and hence are presumably more powerful than systems restricted to a single mode. To emphasize the possibilities provided by sequential acquisition, three applications are described. (CH)

7438 (CONF-730687—, pp 125-136) **Reconstructing pictures from sampled data.** Bone, D.; Pullan, B.R.; Taylor, C.J. (Manchester Royal Infirmary, Eng.). 1973.

From 3. international conference on data handling and image processing in scintigraphy; Cambridge, Massachusetts, USA (6 Jun 1973).

In Information processing in scintigraphy.

Corrections for two important degrading effects in gamma ray imaging systems are described. The adaptive local operator has the advantage that given the assumptions of the method the optimum correction is made for both sources of error simultaneously. The probability operator method although less soundly based in classical signal processing theory does make more use of the known statistical properties of possible inputs and consequently might make a better estimate of the true sample values. A separate correction would need to be made for blurring effects. The initial results indicate that the methods are worthy of further investigation. (auth)

7439 (CONF-730687—, pp 140-152) **Quantitative evaluation of human visual detection performance using empirical receiver operating characteristic curves.** Metz, C.E.; Goodenough, D.J. (Center for Radiologic Image Research, Chicago). 1973.

From 3. international conference on data handling and image processing in scintigraphy; Cambridge, Massachusetts, USA (6 Jun 1973).

In Information processing in scintigraphy.

A basic problem in scintigraphy which will become increasingly important as new imaging devices and new image processing techniques are introduced is that of objectively evaluating any given imaging procedure in terms which will permit meaningful comparison of procedures. Since the clinical usefulness of any scintigraphic image depends upon the ability of human observers to extract information from it, and since the relationship between physical parameters of an image and the ability of human observers to perceive features in the image is not at all clear at present, meaningful conclusions regarding the relative quality of images produced by two procedures can only be decided empirically by measuring the ability of human observers to reach correct decisions after viewing the images. A method of observer performance analysis originally introduced in the field of radar detection and now common in psychophysics is measurement of a Receiver Operating Characteristic (ROC) Curve, which is essentially a plot of the conditional probability of true positive decisions regarding the presence or absence of a signal in the visual field (i.e., probability of a positive response given that a signal is present) versus the conditional probability of false positive decisions (i.e., probability of a positive response given that no signal is present) as the observer's detection threshold or degree of conservatism in calling a questionable situation positive is varied. The possibility of employing ROC curves for evaluation of medical decision making and evaluating radiographic screen-film systems for detection of small image details is discussed. (auth)

7440 (CONF-730687—, pp 153-158) **Observer performance as a measure of goodness in the evaluation of scintigraphic image processing.** Knowles, L.G.; Kohlenstein, L.C.; Schulz, A.G. (Johns Hopkins Univ., Silver Springs, MD). 1973.

From 3. international conference on data handling and image processing in scintigraphy; Cambridge, Massachusetts, USA (6 Jun 1973).

In Information processing in scintigraphy.

Evaluation by human observers seems to be the only really viable method of establishing the worth of the many types of radionuclide image processing. Someday links between mathematical formulations and human performance will become established. When those links are available, the effect of parametric variation in system processing details may be more readily evaluated in a meaningful way, but until these are available, we are constrained and in fact, obligated to using real observers evaluating numerous examples of representative scans. (auth)

7441 (CONF-730687—, pp 159-168) **Progress report on the IAEA co-ordinated research programme on the intercomparison of computer-assisted scintigraphic techniques.** Lewis, B.; Nagai, T. (International Atomic Energy Agency, Vienna). 1973.

From 3. international conference on data handling and image processing in scintigraphy; Cambridge, Massachusetts, USA (6 Jun 1973).

In Information processing in scintigraphy.

The studies at present being carried out under this Program, which has 18 participating centers, are intercomparisons of data-processing techniques for radionuclide image enhancement, particularly as regards their relative merits in improving the detectability of small lesions. It is emphasized that these intercomparisons are not intended to lead to the establishment of a single optimal data-processing technique. It is also emphasized that they have so far been limited to techniques for the digital processing and display of static images. (auth)

7442 (CONF-730687—, pp 173-188) **Use of the Walsh Transform for scintigram enhancement.** Jolley, T.M. Jr. (Franklin MeLean Memorial Research Inst., Chicago); Pizer, S.M. 1973.

From 3. international conference on data handling and image processing in scintigraphy; Cambridge, Massachusetts, USA (6 Jun 1973).

In Information processing in scintigraphy.

The Discrete Walsh Transform (DWT) can be used to reduce the computation time requirements of discrete circular real convolution in the processing of radionuclide images. The standard implementation of discrete convolution uses a forward Fast Fourier Transform (FFT), application of a transfer function (filter) in the Fourier or frequency domain, and an inverse FFT. An alternate approach has been proposed which uses a forward DWT, a linear transformation in the Walsh or sequency domain, and an inverse DWT. This paper is particularly concerned with the computational advantages of the latter approach for the implementation of two-dimensional discrete circular convolution. Utilizing the patterned sparsity and symmetry of the silter matrices, the siltering procedure yields a very good approximation of the desired convolution result while requiring significantly fewer multiplications than the standard implementation of convolution using the FFT or convolution speedup algorithms. (auth)

7443 (CONF-730687—, pp 191-194) **Comparison of the detectability of small lesions in polariod pictures and electro-static printer plotter display.** Erbsmann, F. (Hopital Universitaire St. Pierre, Brussels). 1973.

From 3. international conference on data handling and image processing in scintigraphy; Cambridge, Massachusetts, USA (6 Jun 1973).

In Information processing in scintigraphy.

Display techniques play an important role in the digital handling of scintigraphic data. Most investigators in the field adapt their mathematical procedures to the quality of their display. In the recent IAEA coordinate research program on the intercomparison of scintigraphic techniques, however, no clear cut difference was made between mathematical method and display technique. Different computer displays are discussed and evaluated. (CH)

7444 (CONF-730687—, pp 195-203) **New hard-copy colour display system using ink-jets and its applications in nuclear medicine.** Gustafsson, T. (University Hospital, Lund, Sweden). 1973.

From 3. international conference on data handling and image processing in scintigraphy; Cambridge, Massachusetts, USA (6 Jun 1973).

In Information processing in scintigraphy.

Normally, the color radionuclide scan scale is linear and the colors are arranged in spectral order, since this approach yields the smallest contrast between successive colors and because a human observer can remember this color sequence easily. The color scale can also be multi-cycled, but the number of cycles should not be too great, since as the number of cycles increases, the display approaches a contour map, and the analog properties of the picture are lost. Many cycles also mean that the differentiation between hot-spots and cold-spots can be ambiguous. Besides pictorial images, colors have been used with good results for coding functional images such as those arising from dynamic studies, dual isotope images, and transmission-emission images. A number of different color display techniques in use today are described and compared. (CH)

7445 (CONF-750465—2) **Reconstruction tomography from incomplete projections.** Oppenheim, B.E. (Chicago Univ., Ill. (USA). Dept. of Radiology; Franklin McLean Memorial Research Inst., Chicago, Ill. (USA)). 1975. 46p. Dep. NTIS $5.00.

From Workshop on reconstruction tomography in diagnostic radiology in nuclear medicine; San Juan, Puerto Rico (17 Apr 1975).

In some instances, reconstruction radionuclide tomography must be carried out from projections that do not include projection values for all portions of the object to be reconstructed. This may occur, for example, when the field of view of the detector is limited, or when an opaque foreign body is present within the object. The effects of such incomplete projections upon reconstructions of computer-simulated phantoms were studied, using iterative and convolution methods. Several methods for reducing the resulting artifacts and inaccuracies are discussed. (auth)

7446 (COO—3333-11) **Acquisition, processing and display of gated cardiac scintigrams.** Alpert, N.M.; Chesler, D.A.; McKusick, K.A.; Potsaid, M.S.; Pohost, G.M.; Dinsmore, R.A. (Massachusetts General Hospital, Boston (USA). Radiology Dept.). 1974. Contract AT(11-1)-3333. 4p. (CONF-740531—1). Dep. NTIS $4.50.

From 4. symposium on sharing of computer programs and technology in nuclear medicine; Oak Ridge, Tennessee, USA (8 May 1974).

An improved method for non-traumatic and essentially noninvasive evaluation of left ventricular (LV) function with /sup 99m/Tc as the tracer was developed. This method combines previously used EKG gating techniques for cardiac blood pool visualization with new computerized acquisition, processing and display techniques. An Anger camera, a small computer, and a physiological synchronizer are used to acquire a sequence of eight scintigrams which span the entire cardiac cycle. Under our present protocol two twenty-minute sequences are obtained, one an LAO (50^0) projection, the other an RAO (30^0) projection. Subsequently these images are processed on-line with a digital filter to increase definition of the cardiac borders. The eight images are then displayed sequentially on a specially designed electronic monitor to give an impression of the beating heart somewhat analogous to that obtained with invasive contrast angiography. (auth)

7447 **Positron ranges obtained from biomedically important positron-emitting radionuclides.** Cho, Z.H.; Chan, J.K.; Ericksson, L.; Singh, M.; Graham, S.; MacDonald, N.S.; Yano, Y. (Univ. of California, Los Angeles). *J. Nucl. Med.*; **16**: No. 12, 1174-1176(Dec 1975).

Positron ranges were obtained experimentally for several nuclides used in scintigraphic imaging. The nuclides examined were ^{11}C, ^{13}N, ^{15}O, ^{18}F, ^{68}Ga, and ^{82}Rb. The results are discussed with respect to the ultimate spatial resolution obtained in a scintigraphic image. (auth)

MICROBIOLOGY

7448 **Resource competition and an analytical model of zooplankton feeding on phytoplankton.** Smith, O.L.; Shugart, H.H.; O'Neill, R.V.; Booth, R.S.; McNaught, D.C. (Oak Ridge National Lab., TN). *Am. Nat.*; **109**: No. 960, 571-591(1975).

A new consumer-resource model was developed with specific reference to zooplankton feeding on phytoplankton. In principle, the model can be extended to any terrestrial or aquatic community in which the consumers graze nearly randomly (as described by the grazing rate parameter f/sub i/) on food which has relatively little mobile escape capability. In contrast with the intuitive or phenomenological approaches often used in constructing competition models, we have tried to derive the consumer-resource interaction term from first principles as much as possible. We developed a general form with clearly defined parameters that represent fundamental system processes such as consumer filtering rate. We particularized the model parameters to describe two known forms of feeding: saturation feeding in which the rate remains constant above a given food density while the filtering rate decreases, and inhibited feeding in which a decline appears at high food density. From an examination of the model's equilibrium equations for strongly similar zooplankton species feeding on similar phytoplankton species, we have drawn the following conclusions: The competitive exclusion principle has only limited validity. For a community in which the consumers exhibit no intraspecific competition and have identical assimilation efficiency to death-rate ratios, e/d, any number of consumer species may, in

fact, coexist and compete for the same food. The equations for a complex community composed of many consumer and food species can be reduced to a single equation whose form is identical with that of a single-consumer, single-food system. The standard competition coefficient, α, of the Volterra equation is a poor measure of competition in nonlinear systems. It exhibits incongruous variations with changes in system parameters. We have proposed a new definition of competition coefficient, C/sub in/, which is based on derivatives of state variables evaluated at the system operating point and which eliminates the incongruities exhibited by α. In a community with no intraspecific competition, all C/sub in/ are unity. In a community with intraspecific competition, the C/sub in/ tend to equalize as the number of food species increases, resulting in equal competitive strength of all consumer species in systems of the type studied here. (auth)

MORPHOLOGY

7449 (TID—26936) **Allogromia laticollaris: a foraminiferan with an unusual apogamic metagenic life cycle.** McEnery, M.E.; Lee, J.J. (New York Univ., N.Y. (USA). Dept. of Biology; City Coll., New York (USA)). 1975. 60p. Dep. NTIS $4.50.

The life cycles of three strains of Allogromia laticollaris, a monothalamous foraminiferan, were studied. Each of the strains had a different, nonclassical, and basically apogamic, life cycle. The Cold Spring Harbor (CSH) strain regularly alternated between two agamontic forms: agamont I (uninucleate and diploid) and agamont II (multinucleate and diploid). The complete life cycle took 26 days. Sexual reproduction was rare (0.01%) and autogamous. Small numbers of animals also underwent budding, binary fission, and cytotomy. The life cycles of the Towd Point (TPA) and Sippewissett (SIP) strains were comparatively abbreviated. Agamont II dominated their typical life cycles which were completed in 16 to 18 days. The life cycle of SIP is basically a continuous cycling of the agamont II phase. Approximately 75% of the schizozoites of the TPA strain develop into agamont II. The other 25% alternate between agamont II and agamont I phase. (auth)

PATHOLOGY

7450 **Tumorigenesis by oxygenated nitrosopiperidines in rats.** Lijinsky, W.; Taylor, H.W. (Oak Ridge National Lab., TN). *J. Natl. Cancer Inst.*; **55**: No. 3, 705-708(Sep 1975).

Three oxygenated N-nitrosopiperidines—nitroso-3-piperidinol, nitroso-4-piperidinol, and nitroso-4-piperidone—were prepared and given in drinking water at equivalent molar doses to Sprague-Dawley rats. All were potent carcinogens; 100 percent of the rats developed tumors in all treatment groups. Nitroso-3-piperidinol resembled nitrosopiperidine in inducing a high incidence of tumors of the nasal cavity and upper alimentary tract, and a few liver tumors. Nitroso-4-piperidinol and nitroso-4-piperidone caused a high incidence of tumors of the nasal cavity but very few tumors of the upper alimentary tract. After treatment with the 4-substituted compounds, a high incidence of liver tumors was observed in females but not in males. (auth)

PHYSIOLOGICAL SYSTEMS

7451 (COO—3010-19) **Characterization of biological membranes by physical chemical methods. Progress report, June 1, 1974—May 31, 1975.** Solomon, A.K. (Harvard Univ., Cambridge, Mass. (USA)). 1975. Contract AT(11-1)-3010. 16p. Dep. NTIS $3.50.

Progress is reported on studies of cell membrane permeability of human erythrocytes and Escherichia coli cells. Measuring methods are described. (CH)

7452 (ANL-Trans—1023) **IX. Movements.** Hautt, W. Translated from *Fortschr. Bot.*; **32**: 168-175(1970). 30p. Dep. NTIS $4.00.

Phototropism in plants is discussed with regard to the photoreceptor and its localization, absorption gradient and phototropic perception, and origin of growth differences. The photoreceptor in Phycomycetes and the Avena coleoptile is discussed with regard to its carotinoid or flavin nature and its localization relative to the plasma membrane. Action spectra data are discussed in relation to the chemical nature of the photoreceptor in Phycomycetes, Avena, ferns, mosses, and liverworts. (HLW)

7453 (LF-tr—101) **Experimental proteolytic emphysema and the lung function. (Experiments with dogs).** Islam, M.S.; Konn, G.; Oellig, W.P.; Ulmer, W.T.; Weller, W. Translated from *Pneumonologie;* **151**: 55-71(1974). 24p. Dep. NTIS $3.50.

Inhalation of papain was found to cause emphysema of the lung in dogs and other animals. Following morphological changes, ventilation/perfusion imbalance with arterial hypoxia developed. An increase was observed in lung compliance and in the sensitivity of the sensory receptors of the bronchial system. Pressure in the arteria pulmonalis remained normal until 72 days after the first inhalation of papain. The animals were exposed to papain a total of 5 times over a period of 60 days. We conclude from these studies that emphysema of the lung and airway obstruction are diseases that develop relatively independent of each other. Emphysema of the lung causes only a few changes in lung function that are not very important from the clinical point of view. Airway obstruction is the most important factor for the clinical picture. Glucosteroids could not prevent the morphological and functional changes that followed the inhalation of papain. (auth)

7454 **Kinetic analysis of the estrogen receptor transformation.** Notides, A.C.; Hamilton, D.E.; Auer, H.E. (Univ. of Rochester, NY). *J. Biol. Chem.*; **250**: No. 10, 3945-3950(25 May 1975).

The rate of the 4 to 5 S estrogen-binding protein (EBP) in vitro transformation was measured by sucrose gradient centrifugation analysis. The temperature-activated 4 to 5 S EBP transformation is found to be highly reproducible without loss of [^{3}H]estradiol-binding activity in a buffer containing an excess of [^{3}H]estradiol, 40 mM Tris, 1 mM dithiothreitol, and 1 M urea at pH 7.4. The presence of [^{3}H]estradiol is necessary for the 4 to 5 S EBP transformation. A kinetic analysis of the 4 to 5 S EBP transformation shows that it is a bimolecular reaction, the dimerization of the 4 S EBP with a second (similar or dissimilar) monomer or subunit. In buffers containing 0.4M KCl the apparent second order rate constant is $2.3 \pm 0.2 \times 10^7$ M^{-1} min^{-1} at 28°. The reaction is independent of the initial receptor concentration, suggesting that the 4 S EBP is dissociated into monomeric units in buffers of high ionic strength. In buffers without KCl or with 0.1 M KCl the apparent second order rate constant of receptor transformation increases with decreasing receptor concentration. This suggests that the 4 S EBP is associated weakly with another macromolecule (or macromolecules) in buffers of low ionic strength. The rate of 4 to 5 S EBP transformation shows a 200-fold increase between 0 and 35°. The Arrhenius energy of activation is 21.3 kcal mol^{-1} in buffer without KCl and 19.1 kcal mol^{-1} in buffer with 0.4 M KCl. Following the temperature-activated dimerization, the avidity of binding between the 4 S EBP and its complementary subunit is increased, 0.4 M KCl can no longer cause dissociation, and the 5 S EBP dimer appears. This kinetic analysis indicates that the avidity of binding between the subunits of the estrogen receptor is modulated by estradiol, temperature, and ionic strength. We propose that these interactions of the estrogen receptor's subunits reflect conformational changes involved in receptor activation. (auth)

TRACER TECHNIQUES

7455 (BNWL—1928) **Bioenergetics of three aquatic insects determined by radioisotopic analyses.** McCullough, D.A. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Aug 1975. Contract E(45-1)-1830. 225p. Dep. NTIS $7.60.

The bioenergetics of Simulium spp. and Cheumatopsyche analis from Rattlesnake Springs and Snively Creek, respectively, Benton County, Washington and Tricorthodes minutus from Deep Creek, Oneida County, Idaho were studied using a variety of techniques. Ingestion rates were measured using food sources (diatoms, finely ground watercress, bacteria, and blue-green algae) labelled with ^{51}Cr and ^{14}C. Theoretical ingestion rates were calculated from analyses of gut weights and digestion times. Assimilation efficiencies (AE) were determined using the ^{14}C and dual-label (^{51}Cr, ^{14}C) methods and the ash-ratio technique. The dual-label method provided reliable results when leaching of isotopes from food and feces were not significant. Provided the ^{51}Cr activity density of food is sufficient, the time required for digestion can also be more accurately determined with ^{51}Cr than with ^{14}C. The ash-ratio method provided a wide range of AE values and is not as reliable as the dual-label method because mineral assimilationis unpredictable. Assimilation rates were derived for these animals using the ingestion rate and AE, by several methods employing ^{14}C uptake curves, and by differences in ^{51}Cr- and ^{14}C-derived accumulation values. Methods used to measure other energy budget components are also given. A system was developed for combusting biological samples containing ^{14}C and determining cpm ^{14}C and total carbon from a single sample. This method employs Van Slyke wet oxidation, forced circulation and scrubbing of the gases of combustion, and collection of CO_2 in ethanolamine. Radioactivity in this system was determined by scintillation counting and total carbon by a gravimetric precipitation method. (auth)

7456 Hematologic changes in mice during and after exposure to severe hypobaric hypoxia. Huff, J.E. (Oak Ridge National Lab., TN); Kaufman, G.E.; Ingram, M. *Aviat., Space Environ. Med.*; 46: 1147-1151(Sep 1975).

Exposing mice to an atmospheric pressure of 300 mm Hg for 16 d caused a variety of hematologic effects. Hematocrit increased rapidly in the first 8 d of exposure and slowly in the second 8 d. Reticulocyte counts rose above normal, peaked on day 8, and then fell rapidly toward the control level. Macrocytic erythrocytes, formed during exposure, remained macrocytic after the termination of exposure and after the loss of their reticulum. The posthypoxic mice proved sensitive for erythropoietin bioassay. Mice injected with normal dog serum showed a significantly higher incorporation of Fe-59 than control mice injected with physiologic saline. A reduction of the duration of exposure to 10 d resulted in only a slight decrease in the sensitivity of the mouse bioassay system. However, a 16-d exposure at a pressure of 360 mm Hg resulted in considerably less sensitive bioassay animals. (auth)

BIOMEDICAL SCIENCES, APPLIED STUDIES

RADIATION EFFECTS ON BIOCHEMICALS

IN VITRO

7457 MOLECULAR MECHANISMS FOR REPAIR OF DNA. PART A. DNA REPAIR PROCESS CONFERENCE, SQUAW VALLEY, CALIFORNIA, FEBRUARY 25—MARCH 1, L974. Hanawalt, P.C.; Setlow, R.B. (eds.). Basic Life Sciences, Volume 5A. New York; United States of America (USA); Plenum Press (1975). 460p. (CONF-740231—PA).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974).

Separate abstracts were prepared for thirty-four papers presented at the conference. An additional 23 papers were presented on various aspects of DNA repair. (HLW)

7458 Repairable damage in DNA: overview. Cerutti, P.A. (Univ. of Florida, Gainesville). pp 3-12 of In Molecular mechanisms for repair of DNA. Part A. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974).

See CONF-740231—PA.

The following structural classes of DNA base damage are discussed: monofunctional lesions causing negligible helix distortion; monofunctional lesions causing minor helix distortion, and lesions causing major helix distortion. Lesions causing minor helix distortion are described under the following headings: products with only slightly altered base-pairing and base-stacking properties; and ring-fragmentation, and ring-elimination products. Lesions causing major helix distortion are described under the following headings: monofunctional lesions with bulky substituents or substantially altered base-pairing properties; intercalation damage; and difunctional lesions. (HLW)

7459 Formation of dimers in ultraviolet-irradiated DNA. Brunk, C. (Univ. of California, Los Angeles). pp 61-65 of In Molecular mechanisms for repair of DNA. Part A. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974).

See CONF-740231—PA.

Evidence has been obtained that in uv-irradiated native DNA, pyrimidine dimers are preferentially formed in long pyrimidine tracts. This effect is not the result of the existence of more dimerizable thymine in the long pyrimidine tracts. The preferential formation of dimers in long pyrimidine tracts is enhanced as the dose of irradiation is decreased. These results suggest that the formation of dimers in native DNA occurs by a cooperative mechanism. Quite likely, dimers are formed only in regions of native DNA that are locally denatured (breathing), in which the bases can be aligned. The formation of a dimer in such a breathing region would tend to lock it open and could lead to cooperative formation of dimers in such regions. If this mechanism for the cooperative formation of dimers is operative then it should be restricted to double-stranded DNA. The pyrimidine tracts of irradiated single-stranded DNA all show virtually the same dimer content, irrespective of the length of the tract. These results are consistent with the hypothesis that dimers form cooperatively in breathing regions. (auth)

7460 Photorepair of RNA. Gordon, M.P. (Univ. of Washington, Seattle). pp 115-121 of In Molecular mechanisms for repair of DNA. Part A. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974).

See CONF-740231—PA.

Studies on repair mechanisms operative on RNA are reviewed. Some topics discussed are: photoreactivation of uv-killed RNA by Xanthi plants; relationship between photoinduced lesions and photoreactivation; radioinduced pyrimidine hydrates and pyrimidine cyclobutane dimers in RNA; and relationship between pyrimidine dimers and infectivity of uv-irradiated potato virus X. (HLW)

7461 Beginning of an investigation of the role of recF in the pathways of metabolism of ultraviolet-irradiated DNA in Escherichia coli. Rothman, R.H.; Kato, T.; Clark, A.J. (Univ. of California, Berkeley). pp 283-291 of In Molecular mechanisms for repair of DNA. Part A. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974).

See CONF-740231—PA.

Evidence is summarized that the Rec F pathway engages in the repair of uv-damaged DNA even in the presence of exonuclease I and supplements the Rec BC pathways of repair previously hypothesized. A diagram is presented to show relationships among the several recognized pathways of repair of uv damage. (HLW)

7462 MOLECULAR MECHANISMS FOR REPAIR OF DNA. PART B. DNA REPAIR PROCESSES CONFERENCE, SQUAW VALLEY, CALIFORNIA, FEBRUARY 25—MARCH 1, 1974. Hanawalt, P.C.; Setlow, R.B. (eds.). Basic Life Sciences, Volume 5B. New York; United States of America (USA); Plenum Press (1975). 437p. (CONF-740231—PB).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974).

Separate abstracts were prepared for 52 papers presented at the conference. An additional 13 papers were presented on various aspects of DNA repair. (HLW)

7463 Radiation-induced strand breakage in DNA. Ward, J.F. (Univ. of California, Los Angeles). pp 471-472 of In Molecular mechanisms for repair of DNA. Part B. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974).

See CONF-740231—PB.

Simple model systems were used to characterize the nature of radioinduced DNA strand breaks. Using DNA labeled with [^{3}H] thymidine, it was shown that three monomeric thymine-derived products are released from DNA by irradiation. All three increase with time after irradiation. It was concluded that two post-irradiation time-dependent processes occur in macromolecular DNA: the yield of actual strand breaks increases by a factor of 2; and the chemical nature of the strand break terminus changes, i.e., the yield of monomeric bases continues to increase after the strand break yield has reached a maximum. (HLW)

7464 Inhibition of DNA synthesis by ultraviolet light. Edenberg, H.J. (Stanford Univ., CA). pp 631-633 of In Molecular mechanisms for repair of DNA. Part B. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974).

See CONF-740231—PB.

A model in which uv inhibition of DNA synthesis is due to a halt or pause when the growing point reaches a dimer seems consistent with present data. Ultraviolet irradiation is known to inhibit semiconservative DNA synthesis in mammalian cells, although the mechanism for this inhibition is not known. Models can be grouped into two classes: The inhibition is due to a decrease in the rate of polymerization all along the DNA. The inhibition is due to a halt or pause when the growing point reaches a discrete block to further progress. (auth)

7465 Thymine dimer excision by extracts of human cells. Duncan, J.; Slor, H.; Cook, K.; Friedberg, E.C. (Stanford Univ., CA). pp 643-649 of In Molecular mechanisms for repair of DNA. Part B. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974).

See CONF-740231—PB.

An enzyme activity capable of excising thymine dimers in vitro from uv-irradiated, specifically incised DNA was identified in

extracts of human cells. Experimental results indicate that extracts of human cells grown in tissue culture contain both uv endonuclease and dimer-excision activities. Tables are presented to show effects of uv radiation and effects of freezing cells on thymine dimer excision in cell-free extracts. (HLW)

7466 Current knowledge of the formation and repair of DNA double-strand breaks. Hutchinson, F. (Yale Univ., New Haven). pp 699-702 of In Molecular mechanisms for repair of DNA. Part B. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974).

See CONF-740231—PB.

The types of double-strand breaks in DNA are described, and information on the number produced by x-rays and on the repair of such breaks is summarized. From the current concepts of molecular biology, it is difficult to see how DNA with random double-strand breaks could be replicated. Thus the repair of these breaks is of the greatest importance for the survival of the ability of a cell to self-duplicate, and perhaps for other cell functions. (auth)

RADIATION EFFECTS ON CELLS

7467 Faulty DNA repair following ultraviolet irradiation in Fanconi's anemia. Poon, P.K.; Parker, J.W.; O'Brien, R.L. (Univ. of Southern California School of Medicine, Los Angeles). pp 821-824 of In Molecular mechanisms for repair of DNA. Part B. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974).

See CONF-740231—PB.

Fibroblasts from a patient with Fanconi's anemia were deficient in their ability to excise uv-induced pyrimidine dimers from their DNA but were capable of single-strand break production and unscheduled DNA synthesis. (auth)

EXTERNAL SOURCE

7468 (CONF-750571—1) Molecular dosimetry of chemical mutagens: measurement of molecular dose and DNA repair germ cells. Sega, G.A. (Oak Ridge National Lab., Tenn. (USA)). 1975. 21p. Dep. NTIS $4.50.

From 6. annual meeting of the environmental Mutagen Society; Miami Beach, Florida, USA (9 May 1975).

Molecular dosimetry in the germ cells of male mice is reviewed with regard to in vivo alkylation of sperm heads, in vivo alkylation of sperm DNA, and possible alkylation of sperm protamine. DNA repair in male germ cells is reviewed with regard to basic design of experiments, DNA repair in various stages of spermatogenesis, effect of protamine on DNA repair following treatment with EMS or x radiation, and induction of DNA repair by methyl methanesulfonate, propyl methanesulfonate, and isopropyl methanesulfonate. (HLW)

7469 (CONF-750745—1) Interactions of carcinogens with human cell DNA: damage and repair. Regan, J.D. (Oak Ridge National Lab., Tenn. (USA)). 1975. 18p. Dep. NTIS $4.00.

From Satellite of IUPHAR congress; Turku, Finland (25 Jul 1975).

The DNA of human cells was exposed to UV radiation, gamma radiation, N-acetoxyacetoamino fluorene, 4-nitroquinoline oxide, ethyl methane sulfonate, propane sultone, and ICR-170. Following dBrVrd incubation and exposure to 313 nm radiation the number of strand breaks was recorded; the number of dBrVrd nucleotides inserted was also recorded. The significance of the results is discussed. (HLW)

7470 Absence of a pyrimidine dimer repair mechanism for mitochondrial DNA in mouse and human cells. Clayton, D.A.; Doda, J.N.; Friedberg, E.C. (Stanford Univ. School of Medicine, CA). pp 589-591 of In Molecular mechanisms for repair of DNA. Part B. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974).

See CONF-740231—PB.

We have assayed the ability of mammalian cells to remove pyrimidine dimers from their mitochondrial DNA. The results indicate that pyrimidine dimers are not required for as long as 48 hr after uv irradiation. Furthermore, molecules containing pyrimidine dimers are unable to replicate and are simply diluted out in subsequent cell divisions. (auth)

7471 Repair in mammalian cells: overview. Painter, R.B. (Univ. of California, San Francisco). pp 595-600 of In Molecular mechanisms for repair of DNA. Part B. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974).

See CONF-740231—PB.

Studies on DNA repair in mammalian cells are reviewed. Some topics discussed are: repair of uv and x-irradiated parental DNA; importance of dimers and postreplication repair; role of recombinational events in postreplication repair; and analysis of DNA size by sucrose gradients. (HLW)

7472 Repair (or recovery) effects in quiescent Chinese hamster cells: an attempt at classification. Hahn, G.M. (Stanford Univ. School of Medicine, CA). pp 601-605 of In Molecular mechanisms for repair of DNA. Part B. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974).

See CONF-740231—PB.

Increased survival of density-inhibited Chinese hamster cells after a variety of treatments is analyzed in terms of half-time of repair magnitude of repair, and dependence upon nutrient medium during the repair interval. At least three different systems are identified: x-ray-like, uv-like, and an entirely different system after heat shock. Repair after methyl methanesulfonate and after visible light (in bromodeoxyuridine-substituted cells) may be interpreted as a superposition of the x-ray and uv-like repair systems. (auth)

7473 Postreplication repair of DNA in uv-irradiated mammalian cells. Lehmann, A.R. (Univ. of Sussex, Brighton, Eng.). pp 617-623 of In Molecular mechanisms for repair of DNA. Part B. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974).

See CONF-740231—PB.

Some current controversies concerning the mechanism of post- replication repair in mammalian cells are discussed. We have found that two xeroderma pigmentosum cell lines normal in excision-repair are abnormal in postreplication repair. The rate of postreplication repair is slower than that in normal cells and is caffeine sensitive. In normal human fibroblsasts, caffeine has little effect. (auth)

7474 Synthesis by uv-irradiated human cells of normal-sized DNA at long times after irradiation. Buhl, S.N.; Setlow, R.B.; Regan, J.D. (Univ. of Tennessee, Oak Ridge). pp 625-626 of In Molecular mechanisms for repair of DNA. Part B. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974).

See CONF-740231—PB.

Although the DNA synthesized in human cells within the first hour after irradiation is in smaller segments than in unirradiated cells, the segments made at long times after irradiation are of normal size even though there has been no dimer excision. (auth)

7475 Effects of caffeine on postreplication repair in xeroderma pigmentosum cells. Buhl, S.N.; Regan, J.D. (Univ. of Tennessee, Oak Ridge). pp 627-630 of In Molecular mechanisms for repair of DNA. Part B. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974).

See CONF-740231—PB.

Compared to its effects on unirradiated cells, caffeine inhibited DNA chain elongation and joining in uv-irradiated xeroderma pigmentosum (XP) cells but not in irradiated normal human cells. The drug also inhibited the ability of XP cells to recover and make DNA of normal size at long times after irradiation. (auth)

7476 Postreplication repair in human cells: on the presence of gaps opposite dimers and recombination. Meneghini, R.; Hanawalt, P.C. (Stanford Univ., CA). pp 639-642 of In Molecular mechanisms for repair of DNA. Part B. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974).

See CONF-740231—PB.

Human cells prelabeled with [^{32}P] phosphate were exposed to uv and then pulse-labeled with [^{3}H] thymidine. The DNA from these cells was subsequently treated with T4 endonuclease V, an enzyme which specifically nicks DNA at positions adjacent to pyrimidine dimers. Sedimentation in alkaline sucrose gradients revealed that both the DNA made before and that made after irradiation contained nuclease-sensitive sites, indicating that a

recombinational process between these DNAs might be occurring during postirradiation incubation. Sedimentation in neutral sucrose gradients showed that the molecular weight of native DNA remained unchanged for both DNAs upon endonuclease treatment, indicating that gaps opposite dimers are not necessarily formed after irradiation. (auth)

7477 Studies on DNA repair in mammalian cells: an endonuclease which recognizes lesions in DNA. Bacchetti, S. (State Univ. of Leiden, Rijswijk, Netherlands). pp 651-654 of In Molecular mechanisms for repair of DNA. Part B. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974).

See CONF-740231—PB.

An endonuclease recognizing lesions in uv- and γ-irradiated or depurinated DNA has been detected in human cell extracts and partially purified from calf thymus. Some of its properties and its possible role in DNA repair are discussed. (auth)

7478 Formation and rejoining of DNA strand breaks in x (γ)-irradiated cells in relation to the structure of mammalian chromatic. Lett, J.T. (Harvard Medical School, Boston). pp 655-664 of In Molecular mechanisms for repair of DNA. Part B. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974).

See CONF-740231—PB.

Mammalian cells usually possess the capacity to rejoin disruptions introduced into their deoxynucleoprotein structures by ionizing radiation. I believe that analyses of the strand-break-inducing and the strand-break-rejoining mechanisms operating on the DNA of irradiated cells can provide clues to the nature of the structure of mammalian chromatin in situ. In particular, I wish to consider evidence relevant to the idea that mammalian DNA contains special sites which are sensitive to radiation, alkali, and perhaps other agents and treatments. This concept is usually referred to as the subunit hypothesis. The present communication extends previous arguments along similar lines with an evaluation of more recent data. Since these data have been, or will be, published in the open literature or elsewhere in this book, they will be described here only in general terms. (auth)

7479 CHO cell repair of single-strand and double-strand DNA breaks induced by γ- and α-radiations. Cole, A.; Shonka, F.; Corry, P.; Cooper, W.G. (Anderson Hospital and Tumor Inst., Houston, TX). pp 665-676 of In Molecular mechanisms for repair of DNA. Part B. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974).

See CONF-740231—PB.

Neutral and alkaline sucrose gradient sedimentation analysis was used to measure double- and single-strand breaks in the DNA of Chinese hamster ovary (CHO) cells exposed to either γ- or α-radiation. After irradiation, cells were incubated for 15—180 min to test the ability of the cell to rejoin the DNA breaks. Essentially complete rejoining was observed for single-strand breaks induced by γ- or α-doses below 20 krad and for double-strand breaks induced by γ doses below 60 krad. Approximately 80 percent rejoining was observed for double-strand breaks induced by α doses below 40 krad. At higher doses, the repair system appeared to saturate in such a way that essentially no additional breaks were rejoined. (auth)

7480 Repair of DNA double-strand breaks in mammalian cells and the organization of the DNA in their chromosomes. Lange, C.S. (Univ. of Rochester School of Medicine and Dentistry, NY). pp 677-683 of In Molecular mechanisms for repair of DNA. Part B. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974).

See CONF-740231—PB.

The molecular weight of native DNA has been accurately determined by the use of a semiautomated sucrose gradient system. A monodisperse size distribution (speed dependence free) of eighth-of-a-chromatid pieces [1.7×10^{10} daltons, with 95 per cent confidence (fiducial) limits of +-48 percent] was found. This size has been confirmed by viscoelastometry. Ionizing radiation rapidly breaks each of these pieces into about 21 subunits (again monodisperse) of 8×10^8 daltons each. With increasing dose (greater than 2 krad) the subunits are themselves randomly broken down into even smaller pieces. Postirradiation incubation at 37°C permits the cells to repair both DNA double-strand breaks and intersubunit linkages at the same dose-independent rate (T_{37}) of about 55 min, the same rate as found in Micrococcus radiodurans. The repair data are compatible with a first-order-kinetics repair system, analogous to the post-UV excision-repair system, which becomes saturated at high doses (greater than 60 krad). Specially constructed enzyme gradients show that the linkages contain at least two protein molecules each covalently bound to the end of a subunit and linking the subunits together by a disulfide bond(s). Correlation of cell survival and DNA break kinetics yields two possible models. These are that the two-thirds of the lethal events which are due to improperly or unrepaired double-strand breaks result from either a misrepair frequency of 3.5×10^{-3} (rather high for a mutation frequency) or the induction of a double-strand break in a single eighth-of-a-chromatid unit which is essential for survival but which cannot be repaired, possibly because the unit contains the double-strand break repair system gene(s). (auth)

7481 Kinetics of the single-strand repair mechanism in mammalian cells. Dugle, D.L.; Gillespie, C.J. (Atomic Energy of Canada Ltd., Pinawa, Manitoba). pp 685-687 of In Molecular mechanisms for repair of DNA. Part B. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974).

See CONF-740231—PB.

Alkaline sucrose gradient measurements of single-strand breaks from sublethal x-ray doses yield the same breakage efficiency as from lethal doses. Repair of the breaks is random, first order with a single rate constant, and characterized by 24 kcal/mole activation energy. (auth)

7482 Damage-repair studies of the DNA from x-irradiated Chinese hamster cells. Elkind, M.M. (Argonne National Lab., IL). pp 689-698 of In Molecular mechanisms for repair of DNA. Part B. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974).

See CONF-740231—PB.

Sedimentation studies of the DNA-containing material released from Chinese hamster cells lysed on top of an alkaline sucrose gradient have shown these principal points: after short lysis periods (e.g., approximately 60 min, approximately 25°C), the DNA label from unirradiated cells sediments as a two-peaked pattern; the relative positions of these peaks are strongly dependent on centrifugal force; with increasing lysis time, DNA lost from one peak (the complex, the peak containing lipid) appears in the other (the main peak). The same transition is effected, for a given lysis time, if prior to lysis cells are x-irradiated with small doses (from 100 to 700 rads). Since such doses are in the high survival range (approximately 80 percent to approximately 3 percent, respectively), an association between damage to the complex and survival is suggested. And the cosedimentation of lipid and DNA in the complex is lost after doses that resolve the complex into main-peak DNA, while post-irradiation incubation for repair results in a reformation of the complex plus cosedimentation of lipid and DNA once again. (auth)

7483 Relationship among repair, cancer, and genetic deficiency: overview. Selow, R.B. (Oak Ridge National Lab., TN). pp 711-717 of In Molecular mechanisms for repair of DNA. Part B. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974).

See CONF-740231—PB.

The papers in this section document the following points: many different types of damage to DNA may be repaired; a number of completely different types of damage to DNA may be repaired; chemical and physical carcinogens damage DNA, as indicated by direct observation and by the fact that they provoke the sequence of repair steps in DNA; and the use of xeroderma pigmentosum cells, the analogue of excision-deficient bacterial cells, emphasizes the utility of investigating the effects of chemical carcinogens on human cells. Three large problems remain. The first is the biochemical nature of the complementation process among the various XP groups. The second is the nature of the physical or chemical damage to DNA that results in neoplastic transformation. To date, this is easily approachable only for uv irradiation. The third is the detailed molecular mechanisms by which changes in DNA appear as neoplastic transformation. (auth)

7484 Direct evidence that pyrimidine dimers in DNA result in neoplastic transformation. Hart, R.W.; Setlow, R.B. (Oak Ridge National Lab., TN). pp 719-724 of In Molecular mechanisms for repair of DNA. Part B. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974).

See CONF-740231—PB.

A specific test for the biological role of UV-induced pyrimidine dimers in DNA is photoreactivation (PR). Fish contain large amounts of the PR enzyme. Portions of cell suspensions of

tissue from various organs of the fish Poecilia formosa were exposed to uv radiation (254 nm), then injected into isogenic recipients. An incident fluence of 20 J/m² resulted in 10 percent of the fish with large granulomas and 100 percent with thyroid carcinomas. If the irradiated cell suspension was illuminated with PR light before injection, the yields of both types of lesion were reduced approximately 10-Fold. If the PR light was given before the uv exposure, there was no reduction in the numbers of growths. These experiments show that pyrimidine dimers in DNA can lead to neoplastic transformation. (auth)

7485 Genetic complementation analysis of xeroderma pigmentosum. Bootsma, D.; De Weerd-Kastelein, E.A.; Kleijer, W.J.; Keyzez, W. (Erasmus Univ., Rotterdam). pp 725-728 of In Molecular mechanisms for repair of DNA. Part B. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974).

See CONF-740231—PB.

To characterize the mutations in different unrelated xeroderma pigmentosum (XP) patients, a complementation test was performed using the technique of somatic cell hybridization. DNA repair following uv exposure was studied in multinuclear cells resulting from fusions between in vitro cultivated cells from different patients. The parental XP cells performed low or negligible levels of repair DNA synthesis, whereas in some combinations binuclear hybrid cells showed repair DNA synthesis as a result of complementation. The results indicate the presence of five different complementation groups in XP. (auth)

7486 Use of enzymatic assay to evaluate uv-induced DNA repair in human and embryonic chick fibroblasts and multinucleate heterokaryons derived from both. Paterson, M.C. (Atomic Energy of Canada, Ltd., Chalk River, Ont.); Lohman, P.H.M. pp 735-745 of In Molecular mechanisms for repair of DNA. Part B. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

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A sensitive enzymatic assay has been utilized to monitor repair of uv-induced damage to DNA in primary human and embryonic chick cells in multinucleate heterokaryons artificially derived from both. The assay exploits the unique ability of a purified repair endonuclease to attack uv-irradiated DNA at sites containing pyrimidine dimers. These nuclease-susceptible sites are subsequently observed as single-strand scissions by velocity sedimentation in alkaline sucrose gradients. Incubation of uv-damaged cultures followed by extraction and enzymatic analysis of the radioactively labeled DNA enables one to trace the disappearance of such sites in vivo and hence to monitor endogenous repair activity. When uv-irradiated human cells are incubated in the dark, the curve for site removal exhibits a two-phase exponential decline; i.e., there exists a fast component responsible for elimination of 60 percent of the initial damage and a second one approximately 7 times slower in rate. The removal of sites is not further enhanced by exposing cells to blacklight during post-uv incubation. Conversely, uv-damaged chick cells rid their DNA of all nuclease-susceptible sites rapidly (i.e., at an exponential rate approximately 13 times faster than the fast component of site removal in human cells) when incubated under blacklight but not when kept in the dark. These data indicate the presence in human and embryonic chick cells of distinct enzymatic mechanisms for the elimination of dimer-containing sites. Whereas human fibroblasts rely heavily on a light-independent process, excision-repair, chick fibroblasts possess a light-dependent mechanism, presumably photoenzymatic repair. (auth)

7487 Cytotoxic and mutagenic effects of carcinogenic aromatic amides and polycyclic hydrocarbons and ultraviolet irradiation in normally repairing and repair-deficient (xeroderma pigmentosum) diploid human skin fibroblasts. Maher, V.M.; McCormick, J.J. (Michigan Cancer Foundation, Detroit). pp 785-787 of In Molecular mechanisms for repair of DNA. Part B. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

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The cloning ability of fibroblasts taken from a xeroderma pigmentosum patient proved 2.5 to 3.5 times more sensitive to the cytotoxic effect of active derivatives of carcinogens or to uv irradiation than that of normal cells. They also exhibited a corresponding 2.5- to 3.5-fold greater increase in the frequency of induced mutations to 8-azaguanine resistance per survivor, which might have been expected since these XP cells exhibit less than 20 percent of the DNA-repairing capacity of the normal cells following exposure to such DNA-damaging agents. (auth)

7488 Repair of DNA strand breaks in progeric fibroblasts and aging human diploid cells. Little, J.B.; Epstein, J.; Williams, J.R. (Harvard Univ. School of Public Health, Boston). pp 793-800 of In Molecular mechanisms for repair of DNA. Part B. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

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The rate of rejoining of DNA strand breaks induced by 10 krad of γ-irradiation has been studied in normal human diploid skin fibroblasts and skin fibroblasts from six patients with symptoms of progeria. Although slightly more rapid in very early passage, the repair rate in normal cells was similar throughout most of their life span in vitro. The appearance of cells with reduced repair capacity was evident as the cultures became senescent. The progeric fibroblasts varied greatly in their response to irradiation. The rate of repair was greatly reduced in two strains, whereas in two others extensive DNA degradation was consistently observed in unirradiated cells. Degradation was apparently related to the radiation received from the incorporated radiolabel. Normal repair was seen in progeric fibroblasts transformed by SV40 virus. (auth)

7489 DNA repair and life span of mammals. Hart, R.W.; Setlow, R.B. (Oak Ridge National Lab., TN). pp 801-804 of In Molecular mechanisms for repair of DNA. Part B. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

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The ability of fibroblasts to perform unscheduled synthesis (a measure of excision-repair) after uv irradiation was measured autoradiographically for seven mammalian species at several times after uv irradiation. The initial rate and the maximum incorporation of [³H]dThd increased with the life span of the species. (auth)

7490 Increased DNA excision-repair as pathogenesis of a human leukemia. Huang, A.T.F. (Duke Univ. Medical Center, Durham, NC). pp 805-806 of In Molecular mechanisms for repair of DNA. Part B. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

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At least two possibilities exist which may explain the increasing cell mass in chronic lymphocytic leukemia: CLL cells may have a longer life span than normal cells with identical proliferative capacity or the proliferative capacity may be slightly higher but the difference may be below the limit of detection. The following results suggest that the first possibility is true, in that CLL cells show an increased capacity to repair DNA damage induced by ultraviolet irradiation or x-rays. Compared to normal cells, after irradiation CLL cells incorporate more tritiated thymidine into their DNA, excise pyrimidine dimers (the major uv photoproduct) more rapidly and to a greater extent, and rejoin x-ray-induced strand breaks more rapidly. (auth)

7491 Radiosensitization of a human cell line lacking repair replication. Lee, Y.C.; Kulhanian, F.; Byfield, J.E. (Univ. of California, Los Angeles). pp 807-811 of In Molecular mechanisms for repair of DNA. Part B. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

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A human cell line has been isolated that is deficient in x-ray-induced repair replication. The slope of the radiation survival curve is greater in the presence of the anthracycline antibiotic, adriamycin. The results suggest that radiosensitization by DNA-binding drugs is more probably related to DNA strand breakage phenomena than to the polymerase step of excision-repair. (auth)

7492 Repressible DNA-repair system in mouse neuroblastoma cells. McCombe, P.; Kidson, C. (Univ. of Queensland, Brisbane). pp 813-815 of In Molecular mechanisms for repair of DNA. Part B. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

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Differentiated mouse neuroblastoma cells are extremely sensitive to uv light even though they can undergo excision-repair. A postreplication repair system present in proliferating cells is reversibly repressed in differentiated neuroblasts, and its genetic control is not coupled directly with DNA replication. (auth)

7493 DNA repair and uv resistance in human melanoma. Lavin, M.; Chalmer, A.H.; Kidson, C. (Univ. of Queensland,

Brisbane). pp 817-819 of In Molecular mechanisms for repair of DNA. Part B. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

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Human melanoma cells are highly resistant to 254-nm light. Resistance appears to depend on their ability to continue replication after high uv doses due to the presence of very efficient postreplication repair system, while excision-repair is of relatively minor importance. (auth)

RADIATION EFFECTS ON MICROORGANISMS

BASIC STUDIES

7494 (BNL—20689) **Damages to DNA that result in neoplastic transformation.** Setlow, R.B. (Brookhaven National Lab., Upton, N.Y. (USA)). 1975. 21p. Dep. NTIS $4.50.

Some topics discussed are: correlation between carcinogens and mutagens; defective DNA repair in uv-damaged xeroderma pigmentosum cells; analysis of nucleotide damage to DNA following exposure to chemicals or radiations; photoreactivation in uv-irradiated Escherichia coli; tumor development in fish; excision repair as an aid in identifying damage; detection of excision repair; role of endonucleases in repair of uv damage; and alkylation products and tumors. (HLW)

7495 **Excision-repair of γ-ray damaged thymine in bacterial and mammalian systems.** Hariharan, P.V.; Remsen, J.F.; Cerutti, P.A. (Univ. of Florida, Gainesville). pp 51-59 of In Molecular mechanisms for repair of DNA. Part A. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

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The selective excision of products of the 5,6-dihydroxydihydrothymine type (t′) for γ-irradiated or OsO_4-oxidized DNA or synthetic poly [d(A-T)] was observed with crude extracts of Escherichia coli and isolated nuclei from human carcinoma HeLa S-3 cells and Chinese hamster ovary cells. The results with E. coli extracts allow the following conclusion: The uvrA-gene product is not required for t′ excision; radiation-induced strand breakage is not required for product excision; experiments with extracts of E. coli polAexl showed that the 5′ yields 3′ exonuclease associated with polymerase I is responsible for the removal of t′; experiments with extracts of E. coli endo I lig 4 and the ligase inhibitor nicotinamide mononucleotide showed that polynucleotide ligase accomplishes the last strand resealing step in the excision-repair of t′. Isolated nuclei from HeLa and Chinese hamster ovary cells possess the necessary enzymes for the selective excision of t′ from γ-irradiated or osmium tetroxide oxidized DNA. Approximately 25 to 35 percent of the products were removed from DNA within 60 min. Unspecific DNA degradation was very low. Radiation-induced strand breakage is not required for product removal. (auth)

7496 **Enzymic mechanism of excision-repair in T4-infected cells.** Sekiguchi, M.; Shimizu, K.; Sato, K.; Yasuda, S.; Ohshima, S. (Kyushu Univ., Fukuoka). pp 135-142 of In Molecular mechanisms for repair of DNA. Part A. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

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Excision of pyrimidine dimers from ultraviolet-irradiated DNA in a cell-free system of Escherichia coli infected with bacteriophage T4 consists of two different steps, one to induce a single-strand break at a point close to a pyrimidine dimer and the other to release dimer-containing nucleotide from the DNA. The enzymes responsible for these steps were isolated and the reactions were characterized; T4 endonuclease V introduces a break at the 5′ side of a dimer and 5′ yields 3′ exonucleases, which are also induced by T4, act at the break to excise dimer-containing nucleotides. We isolated temperature-dependent ν mutants, which exhibit increased sensitivity to uv at 42°C but not at 30°C, and found that the mutants induce temperature-sensitive T4 endonuclease V, indicating that the ν gene of T4 is indeed the structural gene for T4 endonuclease V and that the enzyme is responsible for the first step of excision-repair. A possible mechanism of excision-repair in T4-infected cells is discussed. (auth)

7497 **Repair of ultraviolet damage by phage T4: the role of the early phage genes.** Symonds, N. (Univ. of Sussex, Brighton, Eng.). pp 143-147 of In Molecular mechanisms for repair of DNA. Part A. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

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Studies on the role of early T4 genes in the repair of uv damage in phage T4 are reviewed. Some topics discussed are: comparison between uv sensitivity of phage particles and uv sensitivity of bacteria; functional survival of phage T4 early genes; role of early genes in multiplicity reactivation of phage T4; kinetics of DNA synthesis and phage production; and genetic recombination between damaged parental genomes. (HLW)

7498 **Recovery of phage λ from ultraviolet damage.** Devoret, R.; Blanco, M.; George, J.; Radman, M. (CNRS, Gif-sur-Yvette, France). pp 155-171 of In Molecular mechanisms for repair of DNA. Part A. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

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Recovery of phage lambda from ultraviolet damage can occur, in the dark, through three types of repair processes as defined by microbiological tests: host-cell reactivation, prophage reactivation, and uv reactivation. This paper reviews the properties of the three repair processes, analyzes their dependence on the functioning of bacterial and phage genes, and discusses their relationship. Progress in the understanding of the molecular mechanisms underlying the three repair processes has been relatively slow, particularly for uv reactivation. It has been shown that host-cell reactivation is due to pyrimidine dimer excision and that prophage reactivation is due to genetic recombination (prereplicative). We provide evidence showing that neither of these mechanisms accounts for uv reactivation of phage lambda. Furthermore, uv reactivation differs from the other repair processes in that it is inducible and error-prone. Whether uv-damaged bacterial DNA is subject to a similar repair process is still an open question. (auth)

7499 **Escherichia coli uv endonuclease (correndonuclease II).** Braun, A.; Hopper, P.; Grossman, L. (Brandeis Univ., Waltham, MA). pp 183-190 of In Molecular mechanisms for repair of DNA. Part A. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

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An endonuclease from Escherichia coli which acts specifically upon uv-irradiated DNA (correndonuclease II) and is absent from the uvrA and uvrB mutants has been isolated and partially characterized. The enzyme is present in normal amounts in the uvrC mutant. It elutes from phosphocellulose at about 0.25 M potassium phosphate (pH 7.5) and passes through dialysis tubing. The enzyme binds tightly to ur-irradiated DNA but does not bind to unirradiated DNA. The enzyme incises irradiated DNA to the 5′ side of a pyrimidine dimer and leaves a 5′-phosphoryl terminus which can be resealed with polynucleotide ligase. The K/sub m/ of the enzyme is about 1.5×10^{-8} M dimers. Endonucleolytic activity of the enzyme is inhibited by caffeine with a K/sub I/ of about 10mM. (auth)

7500 **Endonuclease II of Escherichia coli.** Goldthwait, D.A.; Kirtikar, D.; Hadi, S.M.; Friedberg, E.C. (Case Western Reserve Univ., Cleveland). pp 191-196 of In Molecular mechanisms for repair of DNA. Part A. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

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Endonuclease II has been purified from Escherichia coli and characterized. The enzyme degrades both alkylated and depurinated DNA, as well as γ-irradiated DNA. It also has been shown to attack DNA containing O^6-methylguanine following treatment of the DNA with the carcinogen methylnitrosurea. (auth)

7501 **Endonuclease III: an endonuclease from Escherichia coli that introduces single polynucleotide chain scissions in ultraviolet-irradiated DNA.** Radman, M. (Harvard Univ., Cambridge, MA). pp 197-200 of In Molecular mechanisms for repair of DNA. Part A. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

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An endonuclease that makes single polynucleotide chain scissions in uv-irradiated DNA has been purified from Escherichia coli. The activity has the following properties: (1) unirradiated DNA is attacked very little if at all; single-stranded DNA is not attacked, whether irradiated or not; there is no requirement for divalent cations, and the activity is not affected by the addition of EDTA; the pH optimum is approximately 7; the activity is in-

hibited by 1 M NaCl, single-stranded DNA, transfer RNA, and unirradiated doubleestranded DNA; the sedimentation coefficient, $S_{20,w}$ is approximately 2.6; it is a basic protein. The enzyme is tentatively named E. coli endonuclease III. The physiological function of the endonuclease has not yet been established. (auth)

7502 Escherichia coli endonuclease which acts on x-irradiated DNA. Strniste, G.F.; Wallace, S.S. (City Univ. of New York, Bronx). pp 201-204 of In Molecular mechanisms for repair of DNA. Part A. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

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An endonuclease activity which acts on x-irradiated DNA has been found in extracts of Escherichia coli. For every single-strand break induced directly in the DNA by x rays, there exists approximately one additional x-ray damage sensitive to this endonuclease. Similar activities have been demonstrated in E. coli B/r and B/sub s-1/, which differ in their repair capabilities. (auth)

7503 Substrate specificity of Micrococcus luteus uv endonuclease and its overlap with DNA photolyase activity. Patrick, M.H. (Univ. of Texas, Dallas). pp 205-208 of In Molecular mechanisms for repair of DNA. Part A. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

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The action of an endonuclease from Micrococcus luteus that operates on uv damage in DNA overlaps with that of DNA photolyase from yeast: homo- and heterocyclobutane dipyrimidines in DNA are substrates for both enzymes, but pyrimidine adducts or the spore photoproduct in DNA are not. As expected from this overlap, the action of the two enzymes is mutually interfering: single-strand nicks introduced by the endonuclease effectively preclude photoreactivation; conversely, formation of a photolyase-cyclobutane dipyrimidine complex can prevent nicking by the endonuclease. (auth)

7504 Role of DNA polymerase I in excision-repair. Glickman, B.W. (Leiden State Univ.). pp 213-218 of In Molecular mechanisms for repair of DNA. Part A. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

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The ability of three different DNA polymerase I mutants of Escherichia coli to carry out excision-repair was examined. Strains having the same genetic origin but carrying either the polA1, polA107, resA1, or pol$^+$ alleles were compared. The rate of ultraviolet-induced dimer excision was slightly reduced, relative to that found in Pol$^+$ strains, in the PolA1 strain; greatly reduced in the PolA107 strain; and found not to occur in the ResA1 strain. Ultraviolet-light-induced repair synthesis as determined by the ultraviolet-stimulated incorporation of ^{3}H-labeled 5-bromo-2′-deoxyuridine into DNA of the parental density showed that the polA1 mutation resulted in an increase in repair replication, while the presence of the polA107 allele caused a reduction in the amount of repair synthesis relative to that of the Pol$^+$ strain. The ResA1 strain, however, showed no ultraviolet stimulation of the incorporation of the density label. These observations indicate that DNA polymerase I plays a key role in the excision-repair process in E. coli. (auth)

7505 Involvement of Escherichia coli DNA polymerase-I-associated 5′ yields 3′ exonuclease in excision-repair of uv-damaged DNA. Heyneker, H. (Leiden State Univ.); Klenow, H. pp 219-223 of In Molecular mechanisms for repair of DNA. Part A. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

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From comparative studies between Escherichia coli PolA107 cells (lacking 5′ yields 3′ exonucleolytic activity associated with DNA polymerase I) and the isogenic wild-type strain, and between the purified DNA polymerase I preparations isolated from these strains, it can be concluded that the 5′ yields 3′ exonuclease is involved in excision of pyrimidine dimers in E. coli. Evidence is presented that the polA107 mutation is located on that part of the DNA polymerase I gene coding for the small fragment on which 5′ yields 3′ exonucleolytic activity is found. (auth)

7506 Enzymatic repair of uv-irradiated DNA in vitro. Hamilton, L.D.; Mahler, I.; Grossman, L. (Brandeis Univ., Waltham, MA). pp 235-243 of In Molecular mechanisms for repair of DNA. Part A. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

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Excision repair of uv-damaged Bacillus subtilis transforming DNA has been carried out by a sequential enzyme system in vitro. Incision adjacent to the pyrimidine dimer in the DNA strand by correndonuclease II-initiated excision of the damage by the 5′ yields 3′-directed exonuclease of the Micrococcus luteus DNA polymerase. Reinsertion of nucleotides into the gap in the strand by the DNA polymerase at 10°C terminated in a single-strand break which was sealed by a polynucleotide ligase, thereby repairing the DNA strand. This restored biological activity to damaged DNA up to doses resulting in 60 percent inactivation of transforming activity. At higher doses, less repair was achieved, due to the development of double-strand breaks during the in vitro incision and excision steps. (auth)

7507 Repair replication in permeabilized Escherichia coli. Masker, W.E.; Simon, T.J.; Hanawalt, P.C. (Stanford Univ., CA). pp 245-254 of In Molecular mechanisms for repair of DNA. Part A. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

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We have examined the modes of DNA synthesis in Escherichia coli strains made permeable to nucleoside triphosphates by treatment with toluene. In this quasi in vitro system, polymerase-I-deficient mutants exhibit a nonconservative mode of synthesis with properties expected for the resynthesis step of excision-repair. This uv-stimulated DNA synthesis can be performed by either DNA polymerase II or III and it also requires the uvrA gene product. It requires the four deoxynucleoside triphosphates; but, in contrast to the semiconservative mode, the ATP requirement can be partially satisfied by other nucleoside triphosphates. The ATP-dependent recBC nuclease is not involved. The observed uv-stimulated mode of DNA synthesis may be part of an alternate excision-repair mechanism which supplements or complements DNA-polymerase-I-dependent repair in vivo. (auth)

7508 Repair by genetic recombination in bacteria: overview. Howard-Flanders, P. (Yale Univ. School of Medicine, New Haven). pp 265-274 of In Molecular mechanisms for repair of DNA. Part A. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

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DNA molecules that have been damaged in both strands at the same level are not subject to repair by excision but instead can be repaired through recombination with homologous molecules. Examples of two-strand damage include postreplication gaps opposite pyrimidine dimers, two-strand breaks produced by x-rays, and chemically induced interstrand cross-links. In ultraviolet-irradiated bacteria, and newly synthesized DNA is of length equal to the interdimer spacing. With continued incubation, this low-molecular-weight DNA is joined into high-molecular-weight chains (postreplication repair), a process associated with sister exchanges in bacteria. Recombination is initiated by pyrimidine dimers opposite postreplication gaps and by interstrand cross-links that have been cut by excision enzymes. The free ends at the resulting gaps presumably initiate the exchanges. Postreplication repair in Escherichia coli occurs in recB$^-$ and recC$^-$ but is greatly slowed in recF$^-$ mutants. RecB and recC are the structural genes for exonuclease V, which digests two-stranded DNA by releasing oligonucleotides first from one strand and then from the other. The postreplication sister exchanges in ultraviolet-irradiated bacteria result in the distribution of pyrimidine dimers between parental and daughter strands, indicating that long exchanges involving both strands of each duplex occur. The R1 restriction endonuclease from E. coli has been used to cut the DNA of a bacterial drug-resistance transfer factor with one nuclease-sensitive site, and also DNA from the frog Xenopus enriched for ribosomal 18S and 28S genes. The fragments were annealed with the cut plasmid DNA and ligated, producing a new larger plasmid carrying the eukaryotic rDNA and able to infect and replicate in E. coli. (auth)

7509 Recombination and postreplication repair. Rupp, W.D.; Levine, A.D.; Trgovcevic, Z. (Yale Univ. School of Medicine, New Haven). pp 307-312 of In Molecular mechanisms for repair of DNA. Part A. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

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The available data concerning postreplication repair are summarized. In Escherichia coli, recombination is implicated in

this repair because the recA$^+$ gene is necessary and because strand exchanges occur that extend over long regions. Other experiments involving phage-induced resistance also point to an interrelation between recombination and repair. In this phenomenon, gene products of lambda bacteriophage are introduced into bacteria, resulting in an increased resistance of the cells when they are subsesequently exposed to x rays. (auth)

7510 Ultraviolet-light-induced incorporation of bromodeoxyuridine into parental DNA of an excision-defective mutant of Escherichia coli. Ley, R.D. (Argonne National Lab., IL). pp 313-316 of In Molecular mechanisms for repair of DNA. Part A. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

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Bromodeoxyuridine-containing regions approximately 1.5 x 10^4 nucieotides in length, and at intervals equivalent to the pyrimidine dimer content of the DNA, have been observed in the parental DNA of an excision-defective strain of Escherichia coli exposed to 10 ergs mm^{-2} at 254-nm followed by prolonged incubation in the presence of bromodeoxyuridine. (auth)

7511 Distribution of pyrimidine dimers during postreplication repair in uv-irradiated excision-deficient cells of Escherichia coli K12. Ganesan, A. (Stanford Univ., CA). pp 317-320 of In Molecular mechanisms for repair of DNA. Part A. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

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During postreplication repair in excision-deficient mutants of Escherichia coli K-12, pyrimidine dimers are gradually lost from uv-irradiated DNA. Our data indicate that dimers are transferred, by a process which may involve genetic exchange, into daughter strands made after irradiation. Dimer transfer appears to continue through several rounds of replication, resulting in the gradual dilution of dimers into successive generations of DNA molecules. (auth)

7512 Experiments on the filling of daughter-strand gaps during postreplication repair. Bridges, B.A.; Sedgwick, S.G. (Univ. of Sussex, Brighton, Eng.). pp 321-324 of In Molecular mechanisms for repair of DNA. Part A. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

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When Escherichia coli deficient in excision-repair replicate their DNA after uv irradiation, the newly synthesized strands contain gaps, presumed to be opposite pyrimidine dimers, which are rejoined during subsequent incubation, by a process believed to be recombinational in nature. The detailed mechanism of postreplication repair is, however, far from clear. We have attempted to answer two somewhat different questions: whether or not the daughter-strand gap persists because of the continued presence of the dimer on the opposite strand, and which if any of the three DNA polymerases are required for filling of daughter-strand gaps. (auth)

7513 Postreplication repair gap filling in an Escherichia coli strain deficient in dnaB gene product. Johnson, R.C. (Medical Univ. of South Carolina, Charleston). pp 325-329 of In Molecular mechanisms for repair of DNA. Part A. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

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Gaps in daughter-strand DNA synthesized after exposure of Escherichia coli E279 to ultraviolet light are filled during reincubation at 30°C for 20 min. Escherichia coli E279 is phenotypically DnaB$^-$ when incubated at 43°C. Cells incubated at 43°C were tested for their ability to complete postreplication repair gap filling. It is concluded that the dnaB gene product is essential for postreplication repair gap filling and that the inhibition seen is not initially the result of degradation. (auth)

7514 Involvement of uvrD, exrA, and recB genes in the control of the postreplicational repair process. Youngs, D.A.; Van der Schueren, E.; Smith, K.C. (Stanford Univ. School of Medicine, CA). pp 331-333 of In Molecular mechanisms for repair of DNA. Part A. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

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Ultraviolet radiation survival studies support the hypothesis that the uvrD, exrA and recB mutations inhibit separate branches of the postreplicational repair process. Results suggest that each of the mutations uvrD, exrA, and recB acts on a branch of the postreplicational repair process which is at least partially independent of those inhibited by the other mutations. Since the uvrB and uvrD exrA recB strain was not as uv sensitive as the uvrB recA strain, at least one additional branch of postreplicational repair, possibly dependent on recF, must be postulated. (auth)

7515 Relationships among repair, mutagenesis, and survival: overview. Witkin, E.M. (Rutgers-the State Univ., New Brunswick, NJ). pp 347-353 of In Molecular mechanisms for repair of DNA. Part A. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

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Studies on pathways of survival, mutagenesis, and repair of genetically damaged cells are reviewed. Some topics discussed are: uv-induced mutations in Escherichia coli; role of pyrimidine dimers in repair of DNA strand breaks; recombinational repair of strand breaks; and role of DNA polymerase in repair of uv damage. (HLW)

7516 Thermal enhancement of ultraviolet mutability in a dnaB uvrA derivative of Escherichia coli B/r: evidence for inducible error-prone repair. Witkin, E.M. (Rutgers-the State Univ., New Brunswick, NJ). pp 369-378 of In Molecular mechanisms for repair of DNA. Part A. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

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DNA damage triggers coordinate expression of a cluster of diverse functions in Escherichia coli, including prophage induction, filamentous growth, and aberrant reinitiation of DNA replication at the chromosomal origin. The SOS repair hypothesis proposes that one of these coordinately inducible functions is an error-prone system of DNA repair (SOS repair) which is responsible for ultraviolet mutagenesis. In dnaB strains, incubation at 42°C stops DNA synthesis and induces lambda prophage and should, therefore, also induce the postulated error-prone repair activity. Thermal posttreatment of a dnaB uvrA derivative of E. coli B/r is found to enhance the yield of ultraviolet-light-induced mutations as much as 50-fold, while having no such effect in the dnaB$^+$ parent strain. The results support the SOS repair hypothesis. The possibility is dicussed that the inducible repair system is a mutagenic DNA polymerase. (auth)

7517 lexB: a new gene governing radiation sensitivity and lysogenic induction in Escherichia coli K12. Blanco, M.; Levine, A.; Devoret, R. (CNRS, Gif-sur-Yvette, France). pp 379-382 of In Molecular mechanisms for repair of DNA. Part A. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974).

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The following topics are briefly discussed: bacterial mutants resistant to thymine deprivation; sensitivity of Escherichia coli mutants to uv and x radiation; effects of uv radiation on DNA degradation; and host-cell reactivation and prophage-reactivation of phage lambda. (HLW)

7518 Indirect suppression of radiation sensitivity of a recA$^-$ strain of Escherichia coli K12. Mount, D.W.; Walker, A.C.; Kosel, C. (Univ. of Arizona, Tucson). pp 383-388 of In Molecular mechanisms for repair of DNA. Part A. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974).

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It has been shown previously that the radiation sensitivity of LexA$^-$ strains of Escherichia coli K-12 can be suppressed by thermosensitive mutations (designated tsl) that are closely linked to the lexA locus. These are thought to be intragenic suppressors that reduce the activity of the diffusible product that gives rise to the lexA$^-$ phenotype (Mount et al., 1973). When a recA mutation is crossed into a suppressed tsl$^-$ strain, the extreme radiation sensitivity usually conferred by a recA mutation is considerably reduced without any detectable change in genetic recombination deficiency. Suppression of uv sensitivity depends upon the activity of the uvrA$^+$ product. We propose that at least part of the radiation sensitivity of a recA$^-$ strain is due to a DNA repair defect that is different from inability to perform genetic exchanges and depends upon the presence of the lexA$^+$ product. We hypothesize that the lexA$^+$ product is a repressor of the synthesis of repair enzymes. In recA$^+$ cells with DNA lesions, repressor is inactivated leading to enzyme induction but this does not occur in recA$^-$ cells. tsl mutations inactivate repressor leading to constitutive enzyme

synthesis and bypassing the need for recA$^+$ product to inactivate the lexA$^+$ product. (auth)

7519 Two-lesion-hypothesis for uv-induced mutation in relation to recovery of capacity for DNA replication. Doudney, C.O. (Albert Einstein Medical Center, Philadelphia). pp 389-392 of In Molecular mechanisms for repair of DNA. Part A. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974).

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The two-lesion hypothesis for uv-induced mutation would include the induction of a lesion damaging the active DNA replication site followed by protein and RNA formation leading to restoration of DNA replication. These events in one way or another would lead to induction of the error-prone repair mechanism. The macromolecules involved in induction of the error-prone mechanism could be the initiation protein and RNA or/and other RNA and protein formed at about the same time as the initiation macromolecules. The other lesion necessary for uv-induced mutation would be a pyrimidine dimer within the length of the potentially mutated gene and subject to repair by the error-prone mechanism. The thermal enhancement of uv mutation in the tif strain of E. coli presumably eliminates the necessity for uv-induction of the DNA synthesis-blocking lesion. (auth)

7520 Effect of genes controlling radiation sensitivity on chemical mutagenesis in yeast. Prakash, L. (Univ. of Rochester, NY). pp 393-395 of In Molecular mechanisms for repair of DNA. Part A. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974).

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Ultraviolet radiation, x radiation, nitrogen mustard, methyl methanesulfonate, and dimethyl sulfate were found to revert all the tester strains with the same efficiency or without any dependence on simple types of base-pair changes, and it was concluded that these mutagens were nonspecific in the types of base-pair changes produced. The cycl-131 tester was used in studies designed to determine the genetic control of mutation induction using a variety of mutagens. The rad 6 and rad g genes greatly reduce the frequency of chemically induced reversion of cycl-131. (HLW)

7521 Influence of repair on the specificity of ultraviolet-induced reversion of an ochre allele of the structural gene for iso-1-cytochtome c. Lawrence, C.W.; Stewart, J.W.; Sherman, F.; Christensen, R. (Univ. of Rochester, NY). pp 397-398 of In Molecular mechanisms for repair of DNA. Part A. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974).

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The specific action of uv on the reversion of the ochre allele cycl-9, in which 21 out of 23 revertants have been shown to arise from A.T-to-G.C transitions at position one in the UAA codon, was found to depend on the function of the RAD6 gene, since cycl-9 reversion occurred by a variety of single-base-pair substitutions in a strain carrying the rad6-1 allele. (auth)

7522 Effect of mutations in lig and polA on uv-induced strand cutting in a uvrC strain of Escherichia coli. Seeberg, E.; Rupp, W.D. (Yale Univ. School of Medicine, New Haven). pp 439-441 of In Molecular mechanisms for repair of DNA. Part B. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974).

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In experiments on the kinetics of strand breakage of bacterial DNA in a uvrC mutant, it was shown that the results are similar to those described earlier for the breakage of superinfecting lambda DNA. In the first several minutes after irradiation, more breaks appear in a uvr strain than in the uvrC mutant, but at later times the situation is reversed. The action of the uvrC gene product may be to interfere with the joining by polynucleotide ligase of the break made by the uv endonuclease. (HLW)

7523 Dependence upon growth medium and the polA, polC, recA, recB, recC, and exrA genes of separate branches of the uvr gene-dependent excision-repair process in Escherichia coli K12 cells. Smith, K.C.; Youngs, D.A.; Van der Schueren, E. (Stanford Univ. School of Medicine, CA). pp 443-451 of In Molecular mechanisms for repair of DNA. Part B. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974).

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The repair of single-strand breaks which arise in DNA during the uvr gene-dependent excision-repair process was examined in certain radiation-sensitive strains of Escherichia coli K12. The results suggest that the excision-repair process may be divided into two branches, one which is dependent on the presence of growth medium and also the rec$^+$ exr$^+$ genotype, and a second which can occur in buffer (growth medium independent) and is largely dependent on DNA polymerase I. DNA polymerase III appears to be involved in the growth-medium-dependent branch of excision repair, and also in the residual growth-medium-independent repair which occurs in polA1 cells. Chloramphenicol, dinitrophenol, and impurities present in some brands of agar all appear to inhibit the growth-medium-dependent branch of excision-repair. The similarities of the two branches of excision-repair to two known pathways for the repair of x-ray-induced DNA chain breaks are discussed. (auth)

7524 Near-uv photoproduct(s) of L-tryptophan: an inhibitor of medium-dependent repair of x-ray-induced single-strand breaks in DNA which also inhibits replication-gap closure in Escherichia coli DNA. Yoakum, G.; Eisenstark, A.; Webb, R.B. (Argonne National Lab., IL). pp 453-458 of In Molecular mechanisms for repair of DNA. Part B. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974).

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Near-uv photoproducts of L-tryptophan (TP), which are especially toxic for recombination-deficient (rec) mutants, were found to inhibit medium-dependent repair of x-ray-induced single-strand breaks. This inhibitor also slows the rate of closure of replication gaps, suggesting that these two processes may have a common pathway (or share a required step which TP can inhibit). (auth)

7525 Radiobiology of DNA strand breakage. Johansen, I. (Univ., Oslo). pp 459-469 of In Molecular mechanisms for repair of DNA. Part B. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974).

See CONF-740231—PB.

The yield of single-strand breaks in lambda DNA within lysogenic host bacteria was measured after exposure to 4-MeV electrons (50 msec) and rapid transfer (45 msec) to alkaline detergent. In nitrogen anoxia the yield was 1.2×10^{-12} DNA single-strand breaks per rad per dalton, and under full oxygenation the yield increased to 5×10^{-12} breaks per rad per dalton. A search for the presence of fast repair mechanisms failed to demonstrate the presence of any mechanism for repair of strand breaks operating within a fraction of a second. Strand breaks produced in the presence of oxygen were repaired in 30—40 sec, while breaks produced under anoxia were rejoined even slower. A functional product from the polAl gene was needed for the rejoining of the broken molecules. Intermediate levels of DNA strand breakage seen at low concentrations of oxygen are dependent on the concentration of cellular sulfhydryl compounds, suggesting that in strand breakage oxygen and hydrogen donors compete for reactions with radiation-induced transients in the DNA. Intercomparisons of data on radiation-induced lethality of cells and single-strand breaks in episomal DNA allow the distinction between two classes of radiation-induced radicals, R_1 and R_2, with different chemical properties; R_1 reacts readily with oxygen and N-oxyls under formation of potentially lethal products. The reactivity of oxygen in this reaction is 30—40 times higher than that of TMPN. R_2 reacts 16 times more readily than R_1 with oxygen under formation of single-strand breaks in the DNA. R_2 does not react with N-oxyls. (auth)

7526 DNA repair in DNA-polymerase-deficient mutants of Escherichia coli. Smith, D.W.; Tait, R.C.; Harris, A.L. (Univ. of California, San Diego). pp 473-481 of In Molecular mechanisms for repair of DNA. Part B. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974).

See CONF-740231—PB.

Escherichia coli mutants deficient in DNA polymerase I, in DNA polymerases I and II, or in DNA polymerase III can efficiently and completely execute excision-repair and postreplication repair of the uv-damaged DNA at 30°C and 43°C when assayed by alkaline sucrose gradients. Repair by Pol I$^-$ and Pol I$^-$, Pol II$^-$ cells is inhibited by 1-β-D-arabinofuranosylcytosine (araC) at 43°C but not at 30°C, whereas that by Pol III$^-$ cells is insensitive to araC at any temperature. Thus, either Pol I or Pol III is required for complete and efficient repair, and in their absence Pol II mediates a limited, incomplete dark repair of uv-damaged DNA. (auth)

7527 Recovery of the priming activity of DNA of x-irradiated Escherichia coli. Zhestyanikov, V.D.; Barenfeld, L.S.; Barskaya, T.V. (Inst. of Cytology, Leningrad). pp 497-500 of In Molecular mechanisms for repair of DNA. Part B. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974).

See CONF-740231—PB.

The template activity of DNA in RNA synthesis in vitro has been studied in Escherichia coli B/r and B/sub s-1/ after exposure to x-rays and postirradiation incubation in growth medium for 60 min at 37°C. The incubation of E. coli B/r after irradiation with 9.3 krad results in the increase of the priming activity of DNA practically to that of unirradiated cells, while after exposure to 18.6 krad the incubation leads to a partial increase in its priming activity. As for E. coli B/sub s-1/, the incubation of the bacteria irradiated with 9.3 krad causes a slight recovery in the priming activity of DNA. (auth)

7528 Repair processes in diverse systems: overview. Hanawalt, P.C. (Stanford Univ., CA). pp 503-506 of In Molecular mechanisms for repair of DNA. Part B. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974).

See CONF-740231—PB.

Studies on DNA repair in several bacterial systems as well as in eukaryotes are reviewed. Some topics discussed are: excision repair of uv damage in Mycoplasma; repair replication in uv-irradiated Tetrahymena; repair of double-strand breaks in DNA of Micrococcus radiodurans; DNA repair in Neurospora; lack of dimer excision in x-irradiated Vicia faba; and DNA repair in Nicotiana, Haplopappus, and Chlamydomonas. (HLW)

7529 Repair of double-strand breaks in Micrococcus radiodurans. Burrell, A.D.; Dean, C.J. (Chester Beatty Research Inst., Sutton, Eng.). pp 507-512 of In Molecular mechanisms for repair of DNA. Part B. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974).

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Micrococcus radiodurans has been shown to sustain double-strand breaks in its DNA after exposure to x-radiation. Following sublethal doses of x-rays (200 krad in oxygen or less), the cells were able to repair these breaks, and an intermediate fast-sedimenting DNA component seemed to be involved in the repair process. (auth)

7530 DNA repair and its relation to recombination-deficient and other mutations in Bacillus subtilis. Ganesan, A.T. (Stanford Univ. School of Medicine, CA). pp 513-519 of In Molecular mechanisms for repair of DNA. Part B. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974).

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DNA repair processes operating in Bacillus subtilis are similar to other transformable bacterial systems. Radiation-sensitive, recombination-deficient mutants are blocked in distinct steps leading to recombination. DNA polymerase I is essential for the repair of x-ray-induced damage to DNA but not for recombination. (auth)

7531 Repair of ultraviolet damage in Haemophilus influenzae DNA. Setlow, J.K.; LeClerc, J.E. (Oak Ridge National Lab., TN). pp 521-524 of In Molecular mechanisms for repair of DNA. Part B. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974).

See CONF-740231—PB.

Excision and postreplication repair in Haemophilus influenzae differ in a number of respects from these well-known repair processes in Escherichia coli. Excision-repair of transforming DNA takes place only after its integration. Like other readily transformable bacteria, Haemophilus influenzae does not contain any photoreactivating enzyme. UV damage in this microorganism is repaired by an excision mechanism and by postreplication repair. (auth)

7532 DNA repair and the genetic control of radiosensitivity in yeast. Haynes, R.H. (York Univ., Toronto). pp 529-540 of In Molecular mechanisms for repair of DNA. Part B. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974).

See CONF-740231—PB.

The following topics are discussed: advantages of yeasts for easily manipulated model systems for studies on molecular biology of eukaryotes; induction of x-ray-resistant mutants by radiations and chemicals; genetics of uv-sensitive mutants; loci of genes affecting radiosensitivity; gene interactions in multiple mutants; liquid-holding recovery; mitotic and meiotic recombination; and repair of yeast mitochondrial DNA. (HLW)

7533 Radiation-sensitive mutants of yeast. Game, J.C. (National Inst. for Medical Research, London). pp 541-544 of In Molecular mechanisms for repair of DNA. Part B. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974).

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Nomenclature for various radiosensitive mutants of Saccharomyces cerevisiae is briefly discussed. Tables are presented to show results of allelism tests of most of the radiosensitive mutants isolated by various investigators together with a standardized rad locus designation and map positions of a number of rad loci in yeast. (HLW)

7534 X-ray-induced dominant lethality and chromosome breakage and repair in a radiosensitive strain of yeast. Ho, K.S.Y; Mortimer, R.K. (Univ. of California, Berkeley). pp 545-547 of In Molecular mechanisms for repair of DNA. Part B. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974).

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The x-ray survival responses of different ploidy rad52 strains and of half-irradiated rad52/rad52 zygotes (dominant-lethal curves) are reviewed. Data from sedimentation velocity experiments which measured double-strand chromosomal DNA breakage and repair are discussed. (auth)

7535 Repair of double-strand breaks in chromosomal DNA of yeast. Resnick, M.A. (Univ. of Rochester, NY). pp 549-556 of In Molecular mechanisms for repair of DNA. Part B. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974).

See CONF-740231—PB.

Ionizing radiation induces double-strand breaks in the nuclear DNA of the yeast Saccharomyces cerevisiae with an efficiency of approximately 0.6×10^{-10} breaks/dalton-krad. Irradiation followed by incubation results in nearly all the breaks being repaired. Based on the efficiency of break production, the sensitivity of a rad52 mutant, and the absence of radiation-induced recombination in such a mutant, it is proposed that the corresponding gene product may be involved in double-strand break repair. A model involving recombination and DNA synthesis is described for this type of repair. (auth)

7536 Fate of uv-induced pyrimidine dimers in the nuclear and mitochondrial DNAs of Saccharomyces cerevisiae on various postirradiation treatments and its influence on survival and cytoplasmic 'petite' induction. Waters, R.; Moustacchi, E. (Inst. du Radium-Biologie, Orsay, France). pp 557-565 of In Molecular mechanisms for repair of DNA. Part B. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974).

See CONF-740231—PB.

The photoreactivability of uv-induced pyrimidine dimers in the nuclear and mitochondrial DNAs of Saccharomyces cerevisiae has been investigated in conjunction with the fate of these photoproducts following postirradiation dark incubation in saline and nutrient media. In all instances, survival and "petite" induction were measured. An attempt has been made to relate these results to present ideas on the repair of uv damages in DNA. (auth)

7537 Genetic control of radiation sensitivity and DNA repair in Neurospora. Schroeder, A.L. (Washington State Univ., Pullman). pp 567-576 of In Molecular mechanisms for repair of DNA. Part B. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974).

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Radiation sensitivity in the fungus Neurospora crassa is under the control of at least eight distinct loci and is also affected by cytoplasmic factors. Although radiation-sensitive mutants which affect inter- or intragenic meiotic recombination have not been isolated, mutants which are defective in the repair of pyrimidine dimers have been found. Evidence from both mutational and biochemical studies shows that Neurospora has an excision-repair

system for pyrimidine dimers which is very similar to the one found in Escherichia coli. Wild-type strains excise dimers, but two mutants, uvs2 and upr1, are uv sensitive and excision defective. Like the E. coli excision-defective mutants, the Neurospora mutants show a greatly increased frequency of uv-induced mutation at low uv doses, and they do not affect recombination. However, they differ from the E. coli mutants in being significantly more sensitive to ionizing radiation than wild-type strains. A third mutant, uvs6, resembles the DNA polymerase-I-negative mutants of E. coli. It is sensitive to both uv and x-irradiation, has a wild-type pattern of uv-induced mutation, and increases spontaneous deletion frequencies. Its polymerases have not been examined. The high frequency of uv-induced mutation in excision-defective strains suggests that a "mutation prone" system of DNA repair exists in Neurospora. (auth)

7538 Enzymes of Neurospora crassa which attack uv-irradiated DNA. Fraser, M.J. (McGill Univ., Montreal). pp 577-579 of In Molecular mechanisms for repair of DNA. Part B. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974).

See CONF-740231—PB.

Two excision-deficient mutants of Neurospora crassa contain normal levels of two enzymes, a single-strand specific endonuclease, which attack uv-irradiated DNA. Mutants of N. crassa have been obtained in which the activity of the latter enzyme as well as an activity with native DNA are simultaneously affected. These activities are also apparently low in excision-proficient uvs3 strain of N. crassa which has many of the characteristics of the recA mutants of E. coli. (auth)

7539 Concerning pyrimidine dimers as 'blocks' to DNA replication in bacteria and mammalian cells. Hewitt, R.R.; Meyn, R.E. (Univ. of Texas System Cancer Center, Houston, TX). pp 635-638 of In Molecular mechanisms for repair of DNA. Part B. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974).

See CONF-740231—PB.

Irradiated uv-sensitive bacteria which are mutant in the uvrA6 locus, and cannot excise pyrimidine dimers, are capable of continued DNA replication with the same orientation as that in unirradiated cells. Replication of dimer-containing DNA is also accomplished by irradiated mammalian cells, suggesting that pyrimidine dimers do not act as absolute blocks to DNA synthesis. Thus, the role that dimers play in reducing the amount and size of DNA synthesized after exposure must be reassessed. (auth)

7540 Use of human adenovirus 2 in the study of the xeroderma DNA-repair defect. Day, R. III. (NIH, Bethesda, MD). pp 747-752 of In Molecular mechanisms for repair of DNA. Part B. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974).

See CONF-740231—PB.

Ultraviolet-irradiated adenovirus 2 assayed by counting plaques on monolayers of human fibroblast strains is up to 30-fold more sensitive than normal if the strains used as viral hosts are prepared from persons having xeroderma pigmentosum. This plaque assay has been used as an extremely discriminating technique in the study of the xeroderma repair defect. With this assay, every xeroderma fibroblast strain tested has been found to exhibit a DNA-repair defect, including those previously judged by other methods to have normal DNA repair. (auth)

7541 Host-cell reactivation of irradiated human adenovirus. Rainbow, A. (McMaster Univ., Hamilton, Ont.). pp 753-754 of In Molecular mechanisms for repair of DNA. Part B. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974).

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Irradiated adenovirus can be used to investigate DNA repair mechanisms in mammalian cells. Recent results suggest that the host-cell reactivation of irradiated human adenovirus reflects, in part at least, a postreplication repair mechanism in the host cell. (auth)

7542 Animal viruses, radiation, repair mechanisms, and cancer. Cameron, K.R. (Pennsylvania State Univ., Hershey). pp 755-761 of In Molecular mechanisms for repair of DNA. Part B. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974).

See CONF-740231—PB.

Effects of radiation on animal viruses are reviewed in terms of repair mechanisms and their possible relationship to virus transformation and carcinogenesis. Repair mechanisms are reviewed under the headings; multiplicity reactivation, photoreactivation, host-cell reactivation (dark repair), and uv reactivation. Other topics discussed are: transformation of cells in vitro by irradiated viruses, oncogenicity of virus-transformed cells in vivo, and possible role of repair mechanisms in virus transformation and oncogenesis. (HLW)

RADIATION EFFECTS ON PLANTS

BASIC STUDIES

7543 (ORO—2583-15) **Cytological study of radiation induced alterations in cytoplasmic factors controlling male sterility in corn. Progress report, February 28, 1975—December 1, 1975.** Edwardson, J.R. (Florida Univ., Gainesville (USA). Inst. of Food and Agricultural Sciences). 1975. Contract AT(40-1)-2583. 14p. Dep. NTIS $4.50.

Progress is reported on the following research projects: cytoplasmic constituents of the embryo of various gymnosperms and angiosperms; cytoplasmic male sterility in corn; modification of cytoplasmic sterility factors using gamma radiation, EMS, and ethidium bromide; selection for sterile, blight-resistant corn plants; electron microscopy study of abnormal mitochondria in cytoplasm of corn; cytoplasmic male sterility in Petunia; non-Mendelian variegation in Petunia and Nicotiana; graft transmission of cytoplasmic male sterility; cytoplasmic male sterility in Vicia faba; and studies on Blakeslee's I virus in Datura. (HLW)

7544 Molecular mechanisms for DNA repair in the blue-green algae. Kraus, M.P. (Univ. of Delaware, Newark). pp 525-528 of In Molecular mechanisms for repair of DNA. Part B. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974).

See CONF-740231—PB.

Techniques and materials used in studies on DNA repair in blue-green algae are described. Mechanisms of repair are discussed with regard to dark repair enzymes, photoreactivation, lysogenic induction, and recombinations of gamma-irradiated superinfecting cyanophage. (HLW)

7545 Absence of pyrimidine dimer excision and repair replication in Chlamydomonas reinhardti. Swinton, D.C. (Univ. of Chicago). pp 585-588 of In Molecular mechanisms for repair of DNA. Part B. Hanawalt, P.C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974).

See CONF-740231—PB.

Chlamydomonas reinhardti is shown to be incapable of performing excision-repair on either its chloroplast or nuclear DNA, since neither repair replication nor pyrimidine dimer excision occurs in either genome. (auth)

RADIATION EFFECTS ON ANIMALS

MAN

7546 (CONF-7410141—1) **Film techniques in radiotherapy for treatment verification, determination of patient exit dose, and detection of localization error.** Haus, A.G.; Marks, J.E. (Franklin McLean Memorial Research Inst., Chicago, Ill. (USA)). 1974. 15p. Dep. NTIS $4.50.

From 14. annual fall symposium of the Society of Photographic Scientists and Engineers; Washington, District of Columbia, USA (24 Oct 1974).

In patient radiation therapy, it is important to know that the diseased area is included in the treatment field and that normal anatomy is properly shielded or excluded. Since 1969, a film technique developed for imaging of the complete patient radiation exposure has been applied for treatment verification and for the detection and evaluation of localization errors that may occur during treatment. The technique basically consists of placing a film under the patient during the entire radiation exposure. This film should have proper sensitivity and contrast in the exit dose exposure range encountered in radiotherapy. In this communication, we describe how various exit doses fit the characteristic curve of the film; examples of films exposed to various exit doses; the technique for using the film to determine the spatial distribution of the absorbed exit dose; and types of errors commonly detected. Results are presented illustrating that, as the frequency of use of this film

technique is increased, localization error is reduced significantly. (auth)

7547 (CONF-751135—1) **Rational approach to patient exposure to radiation in the hospital.** Lanzl, L.H.; Moser, F.L. (Franklin McLean Memorial Research Inst., Chicago, Ill. (USA)). 1975. Contract E(11-1)-69. 11p. Dep. NTIS $4.50.

From Conference on personnel and patient radiation exposure and control in medical facilities; Chicago, Illinois, USA (16 Nov 1975).

During radiotherapy for the treatment of neoplasms the radiation dose needs to be selected with great care and the treatment needs to be carried out with a high degree of precision and accuracy for maximum results. Data are presented on the probability of tumor control of Hodgkin's disease and carcinoma of the supraglottis following radiation treatment. The x radiation dose to patients during various diagnostic radiographic examinations is discussed and several methods are suggested for dose reduction. (CH)

7548 (DP-MS—75-29) **Measured plutonium resuspension and resulting dose from agricultural operations on an old field at the Savannah River Plant in the southeastern United States.** Milham, R.C.; Schubert, J.F.; Watts, J.R.; Boni, A.L.; Corey, J.C. (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Lab.). 1975. Contract AT(07-2)-1. 17p. (CONF-751105—12; SM—199/83). Dep. NTIS $4.50.

From IAEA international symposium on transuranium nuclides in the environment; San Francisco, California, USA (17 Nov 1975).

Plutonium resuspensions, based on air-sample activity, were measured during field preparation and planting of winter wheat at the Savannah River Plant (SRP). Plutonium was originally deposited in the field during the previous twenty years as a result of atmospheric releases from SRP's nuclear fuel processing facility located adjacent to the field, and from global fallout following nuclear weapons tests conducted at other sites. During soil cultivation when the prevailing wind speed ranged from 0 to 6.3 m/sec, airborne plutonium upwind of the field consistently averaged 1.7 femtocurie/m^3. Airborne plutonium concentrations during the various activities associated with site preparation and planting averaged 210 femtocurie/m^3 at 7.6 m and 10 femtocurie/m^3 at 30.5 m downwind from the edge of the field. The air at face level on the tractor contained 49 femtocurie/m^3. The average concentration of plutonium in the 0 to 5 cm soil layer following cultivation was 3100 femtocurie/g. Dose calculations based on measurements of resuspended plutonium indicated that the 70-year bone-dose commitment to an agricultural worker after one hundred 8-hour days would be 49 mrem, 210 mrem, or 1.8 mrem, depending on whether the worker remained in the tractor seat, 7.6 m downwind of the edge of the field, or 7.6 m upwind of the edge of the field. Resuspension factors for the agricultural activities were 103×10^{-8} m^{-1} at 7.6 m downwind, 5×10^{-8} m^{-1} at 30.5 m downwind from the edge of the field, and 24×10^{-8} m^{-1} at the tractor location. (auth)

7549 (LA-UR—75-2259) **Pion radiation therapy.** Kligerman, M.M. (Los Alamos Scientific Lab., N.Mex. (USA)). 1975. Contract W-7405-ENG-36. 13p. (CONF-751060—3). Dep. NTIS $3.50.

From International particle radiation therapy workshop; Key Biscayne, Florida, USA (1 Oct 1975).

Results are summarized from studies on the relative biological effects as compared with x or γ radiation and OER of negative pi mesons produced by the Berkeley 184-inch synchrocyclotron or the NIMROD 7-GeV proton synchrocyclotron at the Rutherford High Energy Laboratory in England using cultured animal cells or Vicia faba cells as the test system. Preliminary results are reported from similar radiobiological studies at the Los Alamos Meson Physics Facility. The relative response of human tissues to peak pion irradiation was compared with 140 kV x rays in a single patient with multiple malignant melanoma by observing the acute response of the skin surrounding metastatic modules following exposure to either pions or x radiation. Color photographs of the irradiated areas made at least twice weekly and densitometry measurements and observations by radiation therapists indicated that maximum erythemia occurred during the fifth, sixth, or seventh week after the start of a schedule of fractionated exposure to 15 fractions over 19 elapsed days. X irradiation was delivered at a dose rate of 500 rads/min to modules to deliver 55, 66, or 75 percent of a skin surface dose of 5,200 rads and pion irradiation, at doses numerically 50 percent of the x ray dose, was delivered at a dose rate of 5 to 7 rads/min. Dose response curves were plotted. Results of histological examinations of skin samples taken 24 weeks following irradiation are reported. Results are discussed relative to the destruction of melanoma cells following pion or x ray treatment. (CH)

7550 (ORNL—4888) **Strategic considerations in planning a counterevacuation.** Chester, C.V.; Cristy, G.A.; Haaland, C.M. (Oak Ridge National Lab., Tenn. (USA)). Dec 1975. Contract W-7405-eng-26. 102p. Dep. NTIS $5.45.

The Soviet Union has highly developed plans to evacuate their population centers in a nuclear confrontation. Their plans include construction of expedient shelters in the outlying areas and continued operation of their essential industry by commuting workers. If they should successfully implement their plan, a subsequent nuclear exchange with the United States would cost them far fewer casualties than they suffered in World War II. Without a corresponding evacuation, the US could lose from 50 to 70 percent of its population. This asymmetry in vulnerability, if allowed to persist, would seriously weaken the bargaining position of the US President. To restore the balance, a great reduction in vulnerability can be achieved most economically by planning a US counterevacuation as a response to a Soviet evacuation. Russian historical experience with murderous invaders, most recently in World War II, has made authoritarian defense measures involving civilians and property in peacetime quite acceptable in their culture. In the US, widescale use of private property and civilian participation in defense activity are not feasible until the development of a grave crisis. Hence US evacuation plans must differ in several important respects from the Soviet plans. However, this preliminary study indicates that the US has ample material resources to move and shelter its population at least as effectively as the Soviet Union. Perhaps the most critical disadvantage of the US is in morale, as evidenced by the widespread misconception that effective survival measures are not possible. (auth)

7551 (ORNL-TM—5139) **Epicenter of the Nagasaki weapon: a reanalysis of available data with recommended values.** Kerr, G.D.; Solomon, D.L. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 29p. Dep. NTIS $5.00.

A significant source of uncertainty in estimates of radiation dose for atomic-bomb survivors of Nagasaki and in correlations of radiation dose with medical effects observed in these survivors is due to unresolved discrepancies in the literature with respect to the location of the epicenter or burst point of the weapon. Available data on the epicenter of the weapon have been reanalyzed in this report using several different approaches. These appear to have resolved some of the major discrepancies found in the literature and to justify a recalculation of radiation doses for the atomic bomb survivors of Nagasaki. A recommended epicenter for recalculating the radiation doses is given in the report. (auth)

7552 (UCRL—77092) **Simplified scheme or radioactive plume calculations.** Gibson, T.A.; Montan, D.N. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 21 Nov 1976. Contract W-7405-Eng-48. 7p. (CONF-760202—11). Dep. NTIS $4.50.

From 9. topical symposium on operational health physics; Denver, Colorado, USA (9 Feb 1976).

A simplified mathematical scheme to estimate external whole-body γ radiation exposure rates from gaseous radioactive plumes was developed for the Rio Blanco Gas Field Nuclear Stimulation Experiment. The method enables one to calculate swiftly, in the field, downwind exposure rates knowing the meteorological conditions and γ radiation exposure rates measured by detectors positioned near the plume source. The method is straightforward and easy to use under field conditions without the help of mini-computers. It is applicable to a wide range of radioactive plume situations. It should be noted that the Rio Blanco experiment was detonated on May 17, 1973, and no seep or release of radioactive material occurred. (auth)

7553 (ERDA-tr—91) **State of immunity of the population during increase in environmental radioactivity.** Mehring, C.E. [nd]. Translation of a German report. 20p. Dep. NTIS $3.50.

Data are summarized on the health status of residents of Hamburg during the past 20 years. The relationship of fallout radioactivity to immunity to diseases is discussed. (CH)

7554 **Doses to the vertebral marrow during common x-ray examinations in clinical situations.** Seidlitz, L.; Margulis, A.R. (Univ. of California, San Franciso). *Invest. Radiol.*; **9**: No. 6, 419-424(1974).

Increasing concern about somatic effects of low doses of x radiation to blood-forming organs led to direct measurements of the exposure of 60 adult patients during actual clinical procedures in a university teaching hospital. The peak skin exposure ranged from 1.99 R for an intravenous pyelogram to 263 R for abdominal angiography. From these measurements, the vertebral marrow doses were calculated and the peak values were found to range from 0.11 to 54 rad. The integral dose to the entire vertebral marrow ranged from 90 to 5400 g-rad in abdominal angiography and from 760 to 2900 g-rad in cardiac cineangiography. The magnitude of these doses points to the need for a conservative ap-

proach to multiple-injection angiography in view of indications of somatic damage from irradiation. The exposure given in these examinations should be consciously minimized. (auth)

7555 **Visual sensations induced by Cherenkov radiation.** McNulty, P.J. (Clarkson Coll. of Technology, Potsdam, NY); Pease, V.P.; Bond, V.P. *Science;* **189**: No. 4201, 453-454(8 Aug 1975).

Pulses of relativistic singly charged particles entering the eyeball induce a variety of visual phenomena by means of Cerenkov radiation generated during their passage through the vitreous. These phenomena are similar in appearance to many of the visual sensations experienced by Apollo astronauts exposed to the cosmic rays in deep space. (auth)

7556 **Ground-level effects of supersonic transports in the stratosphere.** Johnston, H.S. (Lawrence Berkeley Lab., CA). *Acc. Chem. Res.;* **8**: No. 9, 289-294(Sep 1975).

The reduction of stratospheric ozone by nitrogen oxides from supersonic transports is discussed. Methods of measuring the emission index of nitrogen oxides in SST exhaust and ambient stratospheric nitrogen oxides are described. Predictions of the increase in stratospheric nitrogen oxides from SST operations to the year 2025 are discussed. Biological effects of supersonic transport result from the increase in band b UV radiation reaching the earth following reduction of ozone. Effects on human skin and eyes, insects, plants, plankton, and absorption spectra of DNA and erythema are discussed. (HLW)

7557 **Lung cancer at autopsy in A-bomb survivors and controls, Hiroshima and Nagasaki, 1961—1970. II. Smoking, occupation and A-bomb exposure.** Ishimaru, T.; Cihak, R.W.; Land, C.E.; Steer, A.; Yamada, A. (Atomic Bomb Casualty Commission, Hiroshima). *Cancer;* **36**: No. 5, 1723-1728(Nov 1975).

The apparent effect of ionizing radiation on lung cancer in A-bomb survivors has not been large enough to still doubts as to its validity. It has seemed essential to determine whether the apparent radiation effect could have resulted from a confounding of heavy smoking and high radiation dose, or if the occupational exposure of high-dose subjects with lung cancer was suggestive of the influence of environmental hazards other than radiation. The available series consists of 204 subjects with lung cancer verified by autopsy, 61 of whom were low-dose (less than 1 rad) and 13 high-dose (200+ rads) subjects. No evidence could be found that the influence of either smoking or occupational exposure upon lung cancer was exerted so as to suggest that the apparent radiation effect is other than real. The study also provides additional evidence of the relationship between lung cancer and smoking in Japan. (auth)

VERTEBRATES

7558 (CONF-751037—1) **Spermatogonial stem cell renewal in the mouse as revealed by ^{3}H-thymidine labeling and irradiation.** Oakberg, E.F.; Huckins, C. (Oak Ridge National Lab., Tenn. (USA); Baylor Univ., Houston, Tex. (USA). Coll. of Medicine). 1975. 27p. Dep. NTIS $4.50.

From Symposium on stem cells; Montreal, Canada (8 Oct 1975).

Procedures are described for sectioning and staining mouse testes, x-irradiation of mice, and classification of developing sperm cells. Tables are presented to show frequency of labeled cells following exposure to various doses of x radiation. A discussion is presented of types of spermatogonia surviving various radiation doses and times of incorporation of ^{3}H-TdR in the cycle of the seminiferous epithelium. Models of stem cell renewal systems are described. (HLW)

7559 (COO—1748-15) **Neutron-induced mutation experiments. Progress report, March 1, 1975—February 29, 1976.** Abrahamson, S. (Wisconsin Univ., Madison (USA)). Nov 1975. Contract E(11-1)-1748. 24p. Dep. NTIS $3.50.

The relative mutagenic effectiveness of neutrons of different energies were compared with x radiation in mice and Drosophila oogonia employing X-linked recessive lethal and specific locus mutation tests. The energies and doses used were 0.68 MeV, 2 MeV, and 6 MeV (250 and 500^{0}R), and 15 MeV (250, 500, and 1000^{0}R). The data thus far collected from the recessive lethal test indicate that 0.68 MeV neutrons have the highest RBE among the energies tested, followed by 6 and 2 MeV. The specific locus mutation data also indicate the highest RBE for 0.68 MeV, followed respectively by 2 and 6 MeV. The 15 MeV data is as of now incompletely analyzed, as are some dose points of 2 and 6 MeV. (auth)

7560 (COO—3268-18) **Eighteenth year progress report, July 1, 1974—June 31, 1975.** (Jefferson Medical Coll., Philadelphia, Pa. (USA)). 1975. Contract E(11-1)-3268. 36p. Dep. NTIS $5.00.

Progress is reported for studies on the effects of embryonic x irradiation at doses of 50 or 100 R on the lifespan and incidence of leukemia in adult mice and rats. The effects of three 100 R doses on the first day of gestation on cell death in the embryos were also studied. (CH)

7561 (LBL—4250) **Dosimetry for radiobiological experiments using energetic heavy ions.** Smith, A.R.; Stephens, L.D.; Thomas, R.H. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 30 Aug 1975. Contract W-7405-Eng-48. 35p. (CONF-750707—7). Dep. NTIS $4.00.

From Annual meeting of the Health Physics Society; Buffalo, New York, USA (12 Jul 1975).

The availability of the Bevalac facility of energetic heavy ions with range greater than the size of small mammals makes possible the determination of the biological effects of relatively well defined high LET, whole body irradiation. With the increasing application of high-energy heavy ions in radiobiology there is a corresponding need to develop reliable techniques of both relative and absolute absorbed dose measurement. This paper describes dosimetry studies by the Health Physics Department of the Lawrence Berkeley Laboratory with activation detectors, ionization chambers, nuclear emulsion, thermoluminescent dosimeters and X-ray film. The application of these techniques to an experiment designed to study the leukemogenic effect of the whole-body irradiation of mice by 250 MeV/amu carbon ions is briefly described. Values of absorbed dose in tissue, obtained during this experiment, with a nitrogen filled ionization chamber and ^{7}LiF thermoluminescent dosimeters are compared and shown to be in good agreement. As a result of this work a value for the average energy to produce an ion pair (W) in nitrogen by 250 MeV/amu $^{6+}$C ions of 37 +- eV was determined. Values of the efficiency of ^{7}LiF relative to ^{60}Co γ-rays for ions with dE/dx in the range 110-260 MeV g^{-1} cm^{2} are reported. (auth)

7562 (ORNL—5072) **Biology Division annual progress report for period ending June 30, 1975.** (Oak Ridge National Lab., Tenn. (USA)). Nov 1975. Contract W-7405-eng-26. 208p. Dep. NTIS $7.60.

Separate abstracts were prepared for each of the six sections. Four sections were included in Nuclear Science Abstracts and six were included in ERDA Research Abstracts. (HLW)

7563 (ORNL—5072, pp 31-60) **Biophysics and cell physiology.** Mazur, P. Nov 1975.

In Biology Division annual progress report for period ending June 30, 1975.

Progress is reported on research activities in the fields of physiology and low-temperature biology of mammalian embryos; effects of sub-zero temperatures on eggs and embryos of sea urchins; survival of frozen-thawed human red cells; effects of radiation on physiology of Escherichia coli; transfer of triplet electronic energy in dinucleotides; effects of x radiation on DNA degradation; energy deposition by neutrons; photosynthesis; excision repair of uv-induced pyrimidine dimers in DNA of plant cells. (HLW)

7564 (ORNL—5072, pp 61-112) **Genetics and developmental biology.** Barnett, W.E. Nov 1975.

In Biology Division annual progress report for period ending June 30, 1975.

Progress is reported on research activities in the fields of mutagenesis in Haemophilus influenzae and Escherichia coli; radioinduced chromosomal aberrations in mammalian germ cells; effects of uv radiation on xeroderma pigmentosum skin cells; mutations in Chinese hamster ovary cells; radioinduced hemoglobin variants in the mouse; analysis of mutants in yeast; Drosophila genetics; biochemical genetics of Neurospora; DNA polymerase activity in Xenopus laevis oocytes; uv-induced damage in Bacillus subtilis; and others. (HLW)

7565 (ORNL—5072, pp 113-144) **Mammalian genetics.** Russell, W.L. Nov 1975.

In Biology Division annual progress report for period ending June 30, 1975.

Progress is reported on research activities in the fields of translocations and inversions in post-meiotic germ cells of male mice; mutagenicity of sulfur dioxide and ethyl alcohol in mice; mutation frequencies induced in mouse spermatogonia at very low radiation dose rates; discovery of tandem duplication in the mouse; radioinduced hemoglobin variants in the mouse; chemical mutagenesis in mice; protein differences related to genetic differences at single loci; effects of x radiation on DNA synthesis in germ cells of male mice; and others. (HLW)

7566 (ORNL—5072, pp 145-174) **Pathology and immunology.** Storer, J.B. Nov 1975.

In Biology Division annual progress report for period ending June 30, 1975.

Progress is reported on research activities in the fields of radioprotection of mice by phenylhydrazine-damaged erythrocytes; mechanisms of radiation leukemogenesis in mice; recovery of immune competence following sublethal irradiation; effects of fast neutrons and x rays on mouse embryos; effects of x radiation on butylated hydroxytoluene or diethylnitrosamine treatment in mice; effects of neutrons on incidence of neoplastic diseases; DNA synthesis in megakaryocytes; pathogenesis of radioinduced leukemia in mice; recovery from radiation and chemical carcinogenic injury to mouse lung; and others. (HLW)

7567 (UR—3490-511) **Renal and adrenal factors in radiation-induced hypertension and nephrosclerosis.** Lurie, A.G. (Rochester Univ., N.Y. (USA). Dept. of Radiation Biology and Biophysics). 1973. 224p. Dep. NTIS $7.75.

Thesis.

Experiments were conducted in order to investigate the effects of adrenalectomy on the incidence, severity, and rate of progression of radiation-induced hypertension and nephrosclerosis in male rats. Adrenalectomized and non-adrenalectomized rats received either a single exposure of 500 R or 2000 R x radiation bilaterally to temporarily exteriorized kidneys, or a single exposure of 500 R to the whole body with shielding of temporarily exteriorized kidneys. Animals were sacrificed for study at 5 or 10 weeks following surgery and/or irradiation. The parameters which were evaluated included: systolic blood pressure; gross pathology; renal histopathology; food and fluid intake; urine output; urine and plasma potassium, sodium, and chloride concentrations; plasma corticosterone concentration; total body weight; and other organ weights (kidneys, spleen, heart, hypophysis, and adrenals). Additional studies were performed on selected rats to determine: the plasma renin and angiotensin activity; and the effects of adrenalectomy performed 3 months after bilateral renal irradiation on systolic blood pressure and renal histopathology. Hypertension and arteriolonephrosclerosis (ANS) were produced by all doses and all modes of irradiation in all adrenalectomized and non-adrenalectomized rats. (auth)

7568 **Biomedical program leading to therapeutic trials of pion radiation at Los Alamos.** Kligerman, M.M.; Knapp, E.A.; Petersen, D.F. (Univ. of New Mexico, Albuquerque). *Cancer;* **36**: No. 5, 1675-1680(Nov 1975).

Hypoxia and variations in cell cycle phase protect tumor cells being treated with x rays or gamma rays (cobalt). Heavy particles can overcome these protective effects, because of the dense ionization they deposit in tissues. Pions (negative pi mesons) can be directed to and stopped in a specific area, where they are captured by the nuclei of atoms, rendering the nuclei unstable. The nuclei disintegrate, releasing densely ionizing radiation. By confining the dense ionization to the tumor-bearing volume, pions have the potential of increasing the tolerance of the area under treatment to radiation, thus increasing the probability of destroying the tumor. A special channel at the proton factory at the Los Alamos Scientific Laboratory is producing pions for biomedical research. Considerable physical dosimetry has been completed. Cellular studies are under way to provide depth-dose-biological-effect curves. Animal studies will provide information on acute and late effects, which will permit the safe application of pions to a series of anatomical sites established by protocols for radiotherapy clinical trials. (auth)

RADIONUCLIDE EFFECTS - INTERNAL SOURCE

7569 (LA-UR—75-2272) **Occupational exposure estimates for plutonium fuel conversion and fabrication operations.** Mulkin, R.; Mayfield, D.L.; Graf, J.M. (Los Alamos Scientific Lab., N.Mex. (USA)). 1975. Contract W-7405-Eng-36. 7p. (CONF-760202—22). Dep. NTIS $3.50.

From 9. topical symposium on operational health physics; Denver, Colorado, USA (9 Feb 1976).

Estimates were made for occupational exposure associated with operation of two commercial scale production plant models, one a plutonium conversion plant and the other a mixed oxide fuel fabrication plant. The estimates were made by visualizing production and support operations through the viewpoint of a production manager responsible for scheduling and determining manpower requirements. Model plants were described in terms of design basis radiation zones and contamination zones. Control levels for airborne activity appropriate for plutonium operations were used to develop airborne concentrations. Airborne concentrations and dose rates were folded with occupational residence times in each type of zone to generate occupational dose figures. The integrated dose for each occupational group was summed to generate a number for the plant population. Results were 300 man rem per year external exposure for the conversion plant, and 350 man rem per year external exposure for the fabrication plant. Average annual internal dose was greatest for the lung and was found to be 0.16 and 0.19 rem per man (lung dose) at the respective plants. (auth)

MAN

7570 (BNWL-B—450) **PUDEQ: a computer code for calculating dose equivalent from internal deposition of plutonium at Hanford.** Houston, J.R.; Heid, K.R. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Oct 1975. Contract E(45-1)-1830. 42p. Dep. NTIS $5.45.

Presented here are the procedures and mathematical models used in developing PUDEQ, a computer program for computing the dose equivalent to body organs from intake of Pu. The program was designed specifically to use the data recorded on the Hanford Internal Exposure (HIE) System magnetic tape as input. Insofar as was possible, the recommendations of the Advisory Committee on Dose from Plutonium and other Transuranics was followed. Some deviations were made where errors, omissions, or inconsistencies were found, after consultation with members of the Committee. In the current version of the program only Pu and its immediate important daughters are considered. The program could, however, be expanded to include other transuranic nuclides. At present, only a few depositions of transuranic nuclides other than plutonium are recorded out of about 450 individuals involved in a total of over 700 plutonium intakes. (auth)

7571 (BNWL-SA—5463) **Rapid removal of sodium isotopes from the body following accidental internal contamination.** Palmer, H.E. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1975. Contract E(45-1)-1830. 9p. (CONF-751205—3). Dep. NTIS $4.50.

From IAEA international seminar on diagnosis and treatment of incorporated radionuclides; Vienna, Austria (8 Dec 1975).

The extensive use of liquid sodium as the primary coolant for fast breeder reactors presents human safety hazards from both the chemical toxicity of the sodium oxide and the radioactive toxicity of the large quantities of ^{24}Na and ^{22}Na in case of a rupture ir the liquid sodium piping. Although the effects of the chemical toxicity are expected to be very immediate and more severe, the radioactive toxicity is also of significant concern. Other sources of radioactive sodium contamination exist in the nuclear industry. This paper describes some procedures which can significantly reduce the radiation dose to the body from ^{24}Na and ^{22}Na which might be accidentally inhaled or ingested. Studies with rats indicate that the retention time of the sodium isotopes which have exchanged with the body sodium pool can be reduced by a factor of 10 by ingestion of high levels of stable sodium. In addition, the ingestion of a sodium salt at the time or immediately after the inhalation incident could result in at least 60 percent or more of the inhaled radioactive sodium to be excreted before it exchanges with the body sodium pool. The combined effects of both immediate and sustained sodium ingestion in rats can result in a radiation dose from ^{22}Na of only 4 percent or less of that which would result if no additional salt is administered. The dose reduction for ^{24}Na would not be as much as that for ^{22}Na but would be significant. The tolerance for high levels of stable sodium intake in humans will be discussed and optimum intakes will be suggested which will provide the maximum radioactive sodium excretion with minimum harm to the physiological processes of the body. (auth)

7572 (CONF-760202—8) **Detection of internally deposited actinides. Part III. Recent background studies at ORNL.** Good, W.M.; Bemis, C.E.; Goans, R.E. (Oak Ridge National Lab., Tenn. (USA)). 1975. 6p. Dep. NTIS $4.50.

From 9. topical symposium on operational health physics; Denver, Colorado, USA (9 Feb 1976).

It has been apparent from accumulated data at ORNL that the low-energy (less than 100 keV) phoswich background spectrum in the iron-shielded counting facility has components, possibly including a line below 15 keV, whose magnitudes show considerable variability. We have used a planar intrinsic Ge detector designed especially for measuring low-energy photons for background study as part of an evaluation of such a device for in vivo ^{239}Pu measurement. The spectrum that was observed consisted of a continuum upon which were superimposed discrete lines including a strong line at 10.35 keV in addition to the well-known lines from Pb X rays. Detectable also were X rays that corresponded to K-lines of several of the products of the naturally occurring radioactive decay series. Background spectra are presented and the implications of their variability are discussed. (auth)

7573 (CONF-760202—13) **Estimation of dose commitment from an accidental intake of ^{244}Cm.** Bernard, S.R.; Poston, J.W.

(Oak Ridge National Lab., Tenn. (USA)). 1975. 14p. Dep. NTIS $4.50.

From 9. topical symposium on operational health physics; Denver, Colorado, USA (9 Feb 1976).

Four employees at the Oak Ridge National Laboratory experienced an intake by inhalation of ^{244}Cm as a result of an accidental release of this radionuclide. Urine and fecal samples were obtained and were analyzed in the Bioassay Laboratory at ORNL. Also, chest counts were made with the ORNL Whole-Body Counter. Ca-DTPA mists were inhaled within hours after the intake. These data together with data on the inhalation of ^{244}Cm in the dog were used to obtain a 50-year dose commitment to lungs, skeleton, and liver. The 50-year dose commitment to skeleton for two of the employees was estimated to be about 170 rem. The estimation methods used for dose commitment together with the values for other organs obtained are presented and discussed. (auth)

7574 (CONF-760202—19) **Evaluation of two cases of ^{244}Cm inhalation.** Parkinson, W.W.; Henley, L.C.; Goans, R.E.; Good, W.M. (Oak Ridge National Lab., Tenn. (USA)). 1975. 7p. Dep. NTIS $4.50.

From 9. topical symposium on operational health physics; Denver, Colorado, USA (9 Feb 1976).

Chest and systemic burdens were estimated for two employees who inhaled largely soluble compounds of ^{244}Cm. Chest burdens by whole-body counting were: Case A, 28 nCi; Case B, 34 nCi. The urinary excretion of the employees appeared to conform to a series of exponentials similar to those reported for blood and whole-body retention of Am in baboons. Accordingly, retention functions composed of a series of exponentials having 4, 12 to 17, and 72 day half-times were derived from urinary excretion and used to calculate body burdens, Case A, 7 nCi and Case B, 16 nCi. Cumulative fecal excretion by Case B was some 20 times that by Case A (63 nCi vs. 3.2) probably due to differences in deposition in the respiratory tract. Calculated organ doses for the first year were approximately 20 percent of recommended maxima. (auth)

7575 (CONF-760202—20) **Detection of internally deposited actinides. Part IV. Preliminary considerations in the use of large, planar intrinsic Ge detectors.** Bemis, C.E. Jr.; Goans, R.E.; Good, W.M.; Warner, G.G. (Oak Ridge National Lab., Tenn. (USA)). 1975. 4p. Dep. NTIS $4.50.

From 9. topical symposium on operational health physics; Denver, Colorado, USA (9 Feb 1976).

Many inherent advantages are apparent in the use of large planar Ge detectors for the detection, identification, and quantitative assessment of internally deposited actinide nuclides (^{238}Pu, ^{239}Pu, ^{240}Pu, ^{242}Pu, ^{241}Am, ^{244}Cm, ^{246}Cm, and ^{252}Cf). The superior energy resolution in contrast to Phoswich type scintillation detectors, permits isotopic identifications to be made and reduces ambiguities introduced by natural and human background effects. Preliminary studies indicate that a 10 cm^2 x 1.2 cm Ge detector is comparable in detection sensitivity to that of one 125 cm^2 Phoswich detector. Some preliminary considerations and evaluations, photon transport studies based on Monte Carlo modeling and measurements of absolute L-series X-ray yields in the decay of several actinide nuclides, are presented. (auth)

7576 (LA-UR—75-2253) **Operational health physics at the Los Alamos meson physics proton accelerator.** Engelke, M.J. (Los Alamos Scientific Lab., N.Mex. (USA)). 1975. Contract W-7405-Eng-36. 8p. (CONF-760202—23). Dep. NTIS $3.50.

From 9. topical symposium on operational health physics; Denver, Colorado, USA (9 Feb 1976).

The operational health physics practices and procedures at the Clinton P. Anderson Los Alamos Meson Physics Facility (LAMPF), a medium energy, high intensity proton accelerator are reviewed. The operational philosophy used for the control of personnel exposures and radioactive materials is discussed. A particular operation involving the removal of a radioactive beam stop reading in excess of 1000 R/h is described. (auth)

7577 **Plutonium: assessment of the occupational environment.** Schulte, H.P. (Los Alamos Scientific Lab., NM). *Health Phys.*; **29**: No. 4, 613-618(Oct 1975).

From Proceedings of the second Los Alamos life sciences symposium; Los Alamos, NM, USA (22 May 1974).

Attempts to assess the relative hazards (or lack of hazards) associated with plutonium dissemination to the environment emphasize the need for quantitative data to resolve the many unanswered questions regarding environmental plutonium behavior. This review summarizes most of the available data on plutonium in native terrestrial plants and animals and discusses some of the known and speculative mechanisms by which plutonium moves into biota. Factors which require consideration in preparing environmental plutonium safety evaluations are discussed. (auth)

7578 **Plugged haversian canals and skeleton dose in radium cases.** Simmons, D.J.; Keane, A.T.; Holtzman, R.B.; Marshall, J.H. (Argonne National Lab., IL). *Health Phys.*; **29**: No. 5, 767-775(Nov 1975).

The fraction of haversian canals plugged or partially plugged by hypercalcified matrix in skeletons from 30 cases of radium poisoning was found to correlate well with dose, especially as expressed in cumulative rad-yr. There was no significant correlation with age at exposure, age at death, or duration of radium intake either directly or in multiple regression analysis. For 14 of the cases exposed predominantly to ^{228}Ra, cumulative rads (CR) and cumulative rad-yr (CRY) correlated about equally well, but when all 30 cases were considered, including 14 cases exposed predominantly to ^{226}Ra, the correlation coefficient between plugging and CRY was 0.81 (P much less than 0.01), while that with CR was only 0.48 (P less than 0.01). Plugging varied approximately as the square root of either CR or CRY within the range of doses observed (1 to 30 krads and 10 to 700 krad-yr). The expression, (percent plugs)/sup 1.8/, predicts the observed CRY in krad-yr within a factor of two in two-thirds of the cases. Plugging due to radium can probably not be detected below a CR of 1000 rads or a CRY of 10 krad-yr because the normal incidence is the order of 1 percent. Reduced x-ray score for the same 30 cases also correlated with CRY, but not as well as did the plugged canals. (auth)

NUCLIDE KINETICS AND TOXICOLOGY

MAN

7579 (CONF-751126—3) **Gross distribution of ^{241}Am in a man seven years after inhalation.** Toohey, R.E.; Essling, M.A. (Argonne National Lab., Ill. (USA)). 1975. Contract W-31-109-Eng-38. 13p. Dep. NTIS $4.50.

From IAEA international symposium on biological effects of low level radiation pertinent to protection of man and his environment; Chicago, Illinois, USA (3 Nov 1975).

The gross distribution of ^{241}Am remaining in a man seven years after exposure to airborne Am particles was determined by several techniques. Measurements were made of the radiation with NaI(Tl) crystals, one above and one below the supine subject at seven equally spaced points along the long axis. The patterns obtained indicated skeletal deposition in addition to material in the thorax. More detail was obtained from a longitudinal profile scan made at 10 cm intervals with a slit-collimated detector. A general labelling of the skeleton consistent with bone surface deposition was observed, together with a pronounced increased concentration in the thorax. A transverse profile scan was made at the point which had yielded the highest counting rate in the longitudinal scan. Unequivocal evidence for a lung burden was observed in the asymmetry of this scan. The presence of the long-term lung burden was further confirmed by measurements made over the chest with a gas-filled proportional counter. (auth)

7580 (CONF-751205—5) **Excretion rate and retention of plutonium 10,000 days after acquisition.** Rundo, J.; Starzyk, P.M.; Sedlet, J.; Larsen, R.P.; Oldham, R.D.; Robinson, J.J. (Argonne National Lab., Ill. (USA)). 1975. Contract W-31-109-Eng-38. 12p. (SR—6/23). Dep. NTIS $4.50.

From IAEA international seminar on diagnosis and treatment of incorporated radionuclides; Vienna, Austria (8 Dec 1975).

Three persons who had been injected with known amounts of plutonium in 1945 to 1947, were hospitalized on a metabolic ward in 1973. All excreta were collected for at least eight days and the samples were analyzed for plutonium. For the two subjects who had been injected intravenously with tetravalent ^{239}Pu as the citrate, the urinary excretion rates were 7.6 and 4.7 pCi/day at approximately 10^4 days after injection; these rates corresponded to 2.52×10^{-3} percent of the injected doses per day respectively. The fecal excretion rates were about 40 percent of the urinary rates. The third subject received an intramuscular injection of hexavalent ^{238}Pu as the nitrate, in the left leg, which was amputated four days later. Almost 50 percent of the amount injected was found at the injection site and the urinary excretion rate about 9500 days later was 0.06 pCi/day, corresponding to not less than 1.2×10^{-4} percent of the initial systemic burden. The excretion rate and retention of ^{239}Pu up to 10,000 days post-injection were calculated. (CH)

7581 (N—75-17083) **Continued investigation of kinetic aspects of bone mineral metabolism. Final report, 1 February 1973—28 February 1974.** Palmer, H.E. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 26 Feb 1974. Contract NAS9-13235. 29p. (NASA-CR—141607). NTIS $3.75.

The total body calcium in humans was determined by measuring expired Ar-37 after neutron irradiation. The excretion of

Ar-37 from humans was found to be much slower than the excretion from rats and dogs, and to be related to the age of a person. A study of the uniformity of the Ar-37 production throughout the thickness of the body was studied using phantoms. The results indicate that it should be possible to obtain a uniformity within plus or minus 3 percent for the production of Ar-37 per unit of calcium by using a bilateral irradiation. New low background, large volume proportional counters were developed and constructed, for more sensitive measurement of Ar-37 in the expired air from patients. A new irradiation enclosure was developed for measuring total body calcium in rats by the Ar-37 method. With this enclosure the Ar-37 production per gram of calcium is constant with a standard deviation of plus or minus 2.8 percent for any size rat between 100 and 500 grams. The use of Na-22 as measure of bone replacement in the fractured femur of a dog was not successful. (auth)

7582 Animal data on plutonium toxicity. Thompson, R.C. (Battelle Pacific Northwest Labs., Richland, WA). *Health Phys.*; **29**: No. 4, 511-519(Oct 1975).

From Proceedings of the second Los Alamos life sciences symposium; Los Alamos, NM, USA (22 May 1974).

Animal data are necessary in the assessment of plutonium toxicity since it is unlikely that the necessary information on effects from humans will be obtained. Experiments on animals must be designed to provide understanding of the mechanisms at work if the results are to be applied to man since it is a statistical impossibility to design experiments to measure directly the low levels of risk that are of concern. Cancer induction appears to be the risk of greatest concern with the lung and bone apparently the most susceptible organs, depending upon the method of administration. Current limitations on these organs do not appear to have the safety margin formerly believed and there are some uncertainties in the extrapolation from animal data to man. (auth)

7583 Concepts of critical organ and radiation dose as applied to plutonium. Stannard, J.N. (Univ. of Rochester, NY). *Health Phys.*; **29**: No. 4, 539-550(Oct 1975).

From Proceedings of the second Los Alamos life sciences symposium; Los Alamos, NM, USA (22 May 1974).

The concepts of critical organ or tissue and the calculation of radiation dose have been and may well continue to be central to the development of standards for most radionuclides. In the case of plutonium the occupational standard was based on a modification of the direct calculations of maximum permissible annual dose (MPAD) or dose rate but critical organs must still be chosen for different routes of entry and different compounds and for all of the derived standards. Changes in such standards by likely variations in metabolic parameters and models are shown to be significant but not large. Application of the critical organ concept to population exposure standards poses some new problems because the basic MPAD does not distinguish among organs. By-passing some of the problems in present practices by using risk-estimates seems unlikely for plutonium at the present time because of the paucity of human effects data and the fact that the animal experiments used quite different dose regimens from the likely exposure situations to plutonium. A brief comparison is made of radiation and chemical hazard evaluation procedures. (auth)

7584 What we have learned about plutonium from human data. Voelz, G.L. (Los Alamos Scientific Lab., NM). *Health Phys.*; **29**: No. 4, 551-561(Oct 1975).

From Proceedings of the second Los Alamos life sciences symposium; Los Alamos, NM, USA (22 May 1974).

Human data on plutonium deposition, internal distribution, and excretion have been obtained by observations after accidental occupational exposures, long-term follow-up studies on plutonium workers, and autopsy tissue analyses. No significant harmful effects have been noted in humans, although a small foreign-body type nodule around dermal implantations of plutonium has been described in eight persons. Methods used to estimate body burdens by urinary excretion values appear to be conservative generally compared to autopsy tissue burdens. Variations in autopsy tissue distribution appear to be related to the conditions of the plutonium exposure including mode of exposure, particle size, chemical composition, solubility in serum or tissue fluids, and time after exposure for internal redistribution. An important conclusion of this human data survey is the recognition of the inestimable value to be gained by continued careful studies on the life history of workers with higher plutonium exposures. (auth)

7585 Determination of ^{210}Po in urine. Bale, W.F.; Helmkamp, R.W.; Hrynyzyn, V.; Contreras, M.A. (Univ. of Rochester, NY). *Health Phys.*; **29**: No. 5, 663-671(Nov 1975).

To measure ^{210}Po present in normal human urine a technique was developed in which a 4.5 x 11 cm silver foil was shaken at room temperature for 48-hr periods in each of two successive volumes of 1.7 l. of urine acidified to 0.5 N with HCl. Alpha rays were counted with an ionization chamber, coupled to a vibrating reed electrometer, and capable of measuring α-ray pulses originating on both sides of the silver foil serving as a central electrode. The background α-count was less than 2/hr. Analyses of human urine spiked with 0.29 to 0.58 pCi of ^{210}Po, together with studies of urine from dogs carrying significant body burdens of ^{210}Pb, indicated that the average recovery of added ^{210}Po from 1.7 l. volumes of spiked human urine was 72 percent. If it is assumed that the same percentage of ^{210}Po is extracted from non-spiked urine, then the average ^{210}Po concentration found in 13 analyses of 2 x 1.7 l. samples from 26 different pools of fresh human urine was 0.023 pCi/l. Substantial additional ^{210}Po was generated on short aging of the urine through radioactive decay of excreted ^{210}Bi. (auth)

7586 Deposition model of the task group on lung dynamics: a comparison with recent experimental data. Mercer, T.T. (Univ. of Rochester, NY). *Health Phys.*; **29**: No. 5, 673-680(Nov 1975).

A comparison with recent experimental data reveals that the Task Group deposition model adequately describes total deposition during nasal breathing. Measurements made on subjects during normal breathing support the use of Pattle's (Inhaled Particles and Vapours. p203. Pergamon Press. (1969)) empirical equation to define deposition in the nasopharyngeal compartment, but some of the new data indicate that pressure drop across the nose may be a significant parameter in nasal deposition. Although a very limited amount of data on a single subject reported earlier suggests that the Task Group's model may underestimate pulmonary deposition during nasal breathing, extensive results on regional deposition during mouth breathing make it appear that the model generally overestimates pulmonary deposition at the expense of tracheobronchial deposition. (auth)

ANIMALS

7587 (BNWL-SA—5430) **Effect of physico-chemical properties on metabolism of transuranium oxide aerosols inhaled by beagle dogs.** Craig, D.K.; Park, J.F.; Ryan, J.L. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1975. Contract E(45-1)-1830. 28p. (CONF-751073—1). Dep. NTIS $5.00.

From Meeting of the Association for Aerosol Research; Bad Soden, F.R. Germany (16 Oct 1975).

The oxides of four transuranium isotopes (^{238}Pu, ^{239}Pu, ^{241}Am, and ^{244}Cm), prepared by identical methods of calcining the oxalate at 750°C for two hours, had different physico-chemical properties. For all four oxides the density ranges from 9.8 to 11.4 g cm^{-3} and initial ultrafilterability (suspended fraction of activity less than 24 A) varied from 0.002 percent for $^{239}PuO_2$ to 2.24 percent for $^{238}PuO_2$. Dogs were exposed by nose-only techniques to aerosols generated by nebulizing water suspensions of the oxides. The dogs were sacrificed at intervals from one week to about a year postexposure. The rate of translocation of material from lung to other tissues increased from ^{239}Pu to ^{238}Pu to ^{241}Am to ^{244}Cm, possibly reflecting the decrease in mean particle size from an MMD of 0.7 μm to $^{239}PuO_2$ to 0.6 μm for $^{238}PuO_2$ to 0.4 μm for $^{241}AmO_2$ to 0.1 μm for ^{244}CmO/sub x/. Accumulation of the isotopes in the liver and skeleton as a percentage of final body burden was 1 percent ^{239}Pu and 7 to 23 percent for ^{238}Pu at about a year postexposure, while at 270 days postexposure, values were 40 percent for ^{241}Am and 40 to 30 percent for ^{244}Cm. (auth)

7588 (HW—21868) **Plutonium metabolism: a literature review.** Katz, J. (Hanford Works, Richland, Wash. (USA)). 2 Jan 1951. Contract W-31-109-eng-52. 24p. Dep. NTIS $4.50.

A review is presented of the literature on the metabolic behavior of ^{238}Pu and ^{239}Pu in laboratory animals. Information is included on major portals of entry into the body, distribution in tissues, excretion, effects of valence, toxicological studies, and displacement from organs. A list of 58 references is included. (auth)

7589 Plutonium in mammals: influence of plutonium chemistry, route of administration, and physiological status of the animal on initial distribution, and long-term metabolism. Durbin, P.W. (Univ. of California, Berkeley). *Health Phys.*; **29**: No. 4, 495-510(Oct 1975).

From Proceedings of the second Los Alamos life sciences symposium; Los Alamos, NM, USA (22 May 1974).

Current concepts of Pu metabolism are reviewed. Metabolic models of the Pu intake by human populations of mixed age are based on certain over-simplified assumptions which are here considered and the factors that influence the absorption and distribution of Pu in animals and the long-term fate of Pu are discussed. The factors examined include; chemical properties of biological importance, gastrointestinal absorption, absorption from parenteral sites, absorption from the lung, body and tissue distribution of soluble plutonium, plutonium deposition and skeletal maturity, tissue distribution of particulate plutonium, long-term fate of particulate plutonium and of initially soluble plutonium. (UK)

7590 Comparative metabolism of radionuclides in mammals. IX. Retention of ^{75}Se in the mouse, rat, monkey, and dog. Furchner, J.E.; London, J.E.; Wilson, J.S. (Los Alamos Scientific Lab., NM). *Health Phys.;* **29**: No. 5, 641-648(Nov 1975).

Whole-body retention of ^{75}Se-selenite in mice, rats, dogs, and monkeys was determined with 4π liquid scintillation counters after oral and intravenous injection in all species and after intraperitoneal injection in mice and rats. More than 90 percent was absorbed from the gut in all species but monkeys, where much less was absorbed. Retention was described by the sum of three exponentials in all species, whatever the route of administration. Effective half-times of the long components increased with body weight. Radiation protection guides were estimated to be smaller by factors of 3 to 10 than those proposed by the ICRP in 1959. (auth)

7591 Thickness of the deposits of plutonium and radium at bone surfaces in the beagle. Schlenker, R.A.; Marshall, J.H. (Argonne National Lab., IL). *Health Phys.;* **29**: No. 5, 649-654(Nov 1975).

The thickness of the initial deposit of ^{239}Pu at endosteal bone surface in a beagle dog was found to be less than or equal to 0.2 μm 90 days after injection of monomeric ^{239}Pu. For ^{226}Ra the thickness of the endosteal surface deposit was found to be less than or equal to 6.5 μm 5 hr after injection. The thicknesses were determined by measuring the energy loss of α-particles emitted from the bone surfaces. If ^{239}Pu were deposited in uniform concentration to a depth of 0.2 μm, then the rate of escape of α-particle energy from the surface would be 98 percent of that from a plane surface source of infinitesimal thickness. For ^{224}Ra uniformly deposited to a depth of 5 μm, the energy escape would be 76 to 81 percent of that from surface source of infinitesimal thickness, depending on the assumption made about retention of daughter products. (auth)

7592 Fractional radon retention in bone. Mays, C.W.; Lloyd, R.D.; Van Dilla, M.A. (Univ. of Utah, Salt Lake City). *Health Phys.;* **29**: No. 5, 761-765(Nov 1975).

Radon-to-radium ratios have been measured in defleshed, canned, and frozen bones of 50 beagles dying 5 to 2988 days after the intravenous injection of ^{226}Ra. The expression Rn/Ra = (0.075 +- 0.010)t/sup 0.158 +- 0.004/ (1 - e/sup -0.181 t/) at t days describes the dependence of the Rn/Ra ratio in these bones upon time after administration, and was shown to be independent of age at injection or relative injected activity. This equation also appears valid for dogs that received their radium in six equal injections spaced over a period of 280 days, when t is considered as time after midinjection, at least when the time after mid-injection exceeds the duration of injections. Comparison of results for dogs with those reported for mice, rats, chinchillas, and humans showed that about 68 percent of the individual values for these other species were within +- S. D. of the equation for beagles. This suggests that skeletal Rn/Ra ratios as a function of time may be somewhat species independent. Therefore, these ratios depend almost exclusively upon the time following radium deposition. (auth)

7593 Ca—DTPA toxicity in the mouse fetus. Fisher, D.R.; Mays, C.W.; Taylor, G.N. (Univ. of Utah, Salt Lake City). *Health Phys.;* **29**: No. 5, 780-782(Nov 1975).

It has been shown in previous work that Ca-DTPA is only slightly more effective than Zn-DTPA in the removal of actinide metals from experimental animals but that treatment with the calcium chelate can have toxic side effects. An investigation of the effect of Ca-DTPA and Zn-DTPA injections of female mice on their developing fetuses is reported. Injection schedule and birth data are tabulated. There were no viable offspring produced by dams injected daily with 2.9 mmole Ca-DTPA/kg; with an injection dosage of 0.36 mmole Ca-DTPA/kg fecundities were near normal, as were fetal development and growth rates during the lactation period. On the other hand by using the same levels of dosage with zinc trisodium chelate no apparent harm was suffered by either mothers or pups. It is concluded that while both the calcium and zinc salts of DTPA are highly effective chelating agents, the demonstrated fetal toxicity of the calcium chelate indicates that Ca-DTPA should not be given to a woman who might be pregnant. If chelation therapy is warranted, the much safer Zn-DTPA, rather than Ca-DTPA, should be used. (UK)

7594 Possible mechanism in bronchopulmonary lavage. Morken, D.A. (Univ. of Rochester, NY). *Health Phys.;* **29**: No. 5, 790-791(Nov 1975).

A new treatment of data previously reported by Boeker et al. (Health Phys.; 26: 505 (1974)) of bronchopulmonary lavage of dogs is presented. In this treatment the fraction of total removable material which remained in the lung at the end of each 1 litre collection of saline is shown from which a half-value of wash volume of about 1.3 litre is obtained. Resulting from this approach a new mechanism in bronchopulmonary lavage is suggested. If this washout process is a reasonable explanation of the phenomenon observed, useful conclusions can be made about the method and its importance when applied to the removal of radioactive particles from the lung. (UK)

7595 Removal of inhaled $^{239}PuO_2$ from beagle dogs by pulmonary lavage. McDonald, K.E.; Park, J.F.; Dagle, G.E.; Sanders, C.L.; Olson, R.J. (Battelle Pacific Northwest Labs., Richland, WA). *Health Phys.;* **29**: No. 5, 804-805(Nov 1975).

Of beagle dogs which had been exposed to a submicron aerosol of $^{239}PuO_2$ some were treated by sessions of pulmonary lavage and some by a course of DTPA injections. It was shown that DTPA treatment had no significant effect on the retention, excretion, or translocation of inhaled $^{239}PuO_2$. Periodic right lung lavage removed a total of about 50 percent of the ^{239}Pu present in the right lung, or about 27 percent of the total lung ^{239}Pu burden. The effectiveness of pulmonary lavage in removing ^{239}Pu decreased with time after exposure and/or with increasing number of lavage sessions. It is estimated that about 50 percent of the initial alveolar lung burden of $^{239}PuO_2$ would have been removed, had both sides of the lung been lavaged. (UK)

7596 DTPA therapy of ^{241}Am from a simulated wound site. Lloyd, R.D.; Taylor, G.N.; Mays, C.W.; McFarland, S.S.; Atherton, D.R. (Univ. of Utah, Salt Lake City). *Health Phys.;* **29**: No. 5, 808-811(Nov 1975).

The results of an investigation to determine the effect of daily injections over a period of 10 weeks of Zn-DTPA on the distribution of ^{241}Am from a simulated wound site on the carpal pad of beagles are reported. It is shown that daily injections of Zn-DTPA hastened the disappearance of ^{241}Am from the simulated wound site, prevented almost completely the translocation from the depot to the liver and skeleton, and reduced significantly the total body ^{241}Am content through increased excretion. Dividing the daily total administration of Zn-DTPA into five equal fractions given at about 5-hr intervals seemed to increase somewhat the effectiveness of this chelating agent relative to the administration of the same daily total given in a single injection each day. (UK)

THERMAL EFFECTS

7597 (PB—239347) Effect of temperature and chemical pollutants on the behavior of several estuarine organisms. Meldrim, J.W.; Gift, J.J.; Petrosky, B.R. (Ichthyological Associates, Inc., Middletown, Del. (USA)). Dec 1974. Contract DI-14-31-0001-3677. 139p. (BULL—11). NTIS $5.75.

The increased use of estuarine waters for cooling purposes by steam electric generating stations requires that responses of affected fishes and macroinvertebrates to temperature and to the anti-fouling chemical, chlorine, be known. Behavioral avoidance responses to temperature and to chlorine were determined under various combined conditions of salinity, light level, and level of dissolved oxygen over the annual range of temperatures found in the Delaware River estuary. Physiological responses in terms of metabolic rate and scope for activity were determined for different levels of salinity over the same annual range of estuarine temperatures. Multiple regression analysis was used to estimate avoidance temperatures, concentrations of chlorine which would be avoided, and active and resting metabolic rates. Acclimation temperature was the dominant factor influencing the response level in all these studies. However, the effects of the other variables under study significantly affected the response as well as the effect of acclimation temperature. Further, these variables were found to interact such that the effects of the individual variables were not consistent. In several cases, these interactions were more important in determining the response level than the main effects of their components. Data and graphs showing these effects are presented. (GRA)

7598 (PB—239670) Delaware estuary system: environmental impacts and socio-economic effects. Biological condition of the deepwater portion of lower Delaware Bay. Final report (partial). Maurer, D. (Delaware Univ., Newark (USA). Coll. of Marine Studies). May 1974. 95p. NTIS $4.75.

See also PB—239671 and PB—239669.

The purpose of this report is to briefly describe the biological condition of the deepwater portion of lower Delaware Bay. To accomplish this, it was necessary to examine many scientific sources, thus providing a review of research in the marine biology of the area. Deep water as used in this report refers to subtidal portions of the Delaware Bay region. Lower Delaware Bay refers to the area from the Chesapeake-Delaware Canal to the mouth of the bay and adjacent coastal waters. The main emphasis is placed on the area from Woodland Beach to the mouth of the bay. The report is divided into three main sections: Description of the biolo-

gy of the area, description of man's activities on the biology of the area, and problems for future research. (GRA)

CHEMICALS METABOLISM AND TOXICITY

7599 (PB—239194) **Continuous flow kinetic model to predict the effects of temperature on the toxicity of waste to algae.** Reynolds, J.H.; Middlebrooks, E.J.; Porcella, D.B.; Grenney, W.J. (Utah State Univ., Logan (USA). Utah Water Research Lab.). Jun 1974. Contract DI-14-31-0001-3659. 119p. (PRWG—105-3). NTIS $5.25.

Many industries, such as pulp and paper mills, tanneries, and oil refineries, discharge toxic wastes at extremely high temperatures. The temperature of an oil refinery waste may range from 22°C to 41°C. These high temperatures could have a significant effect on the toxicity of a given waste. Therefore, it is necessary to develop relationships which will evaluate and predict the effects of increased temperature on the toxicity of various wastes. Equations have been developed utilizing continuous flow stirred tank reactor kinetics and enzyme inhibition kinetics to describe the effects of temperature on toxicity to microorganisms. These equations were tested by semicontinuous and continuous flow experiments with phenol and the algae Selenastrum capricornutum. Comparison of the competitive inhibition constants, KI, for S. capricornutum exposed to phenol at 20°C, 24°C, and 28°C, indicates that phenol toxicity increases with an increase in temperature according to the Arrhenius function. (GRA)

OTHER ENVIRONMENTAL POLLUTANT EFFECTS

7600 (SAND—75-0494) **Approach to biological response to microwaves: a preliminary thermal versus non-thermal experiment.** Wayland, J.R.; Brannen, J.P.; Morris, M.E. (Sandia Labs., Albuquerque, N.Mex. (USA)). Oct 1975. Contract AT(29-1)-789. 18p. Dep. NTIS $4.50.

The problem of separating thermal and non-thermal effects in the response of biological systems to imposed microwave fields often masks the contribution from non-thermal interactions. This note presents an approach to the separation problem and its application to a preliminary experiment. The response selected was spore inactivation rate. (auth)

HEALTH AND SAFETY

7601 (COO—3017-23) **Safe handling of tissue containing radioactive substances.** Warren, S. (New England Deaconess Hospital, Boston, Mass. (USA)). 1975. Contract E(11-1)-3017. 6p. (CONF-751143—1). Dep. NTIS $4.50.

From Meeting on safe handling of tissue containing radioactive substances; Philadelphia, Pennsylvania, USA (7 Nov 1975).

Patients recently treated with radioactive isotopes may present problems or even hazards during physical examination, surgery, or autopsy, especially following the use of ^{131}I and ^{198}Au. ^{32}P is rarely a significant hazard. Contamination of victims of radiation accidents may be a problem initially, but they are usually promptly decontaminated. Guidance of the hospital's radiation safety officer is helpful, particularly with regard to handling of contaminated persons or materials. Long-lived isotopes, such as radium or thorotrast, are usually present in too low concentration to be dangerous. (auth)

7602 (EPA—520/7-75-014) **EPA review of radiation protection activities, 1974.** (Environmental Protection Agency, Washington, D.C. (USA). Office of Radiation Programs). Sep 1975. 114p. U.S. Environmental Protection Agency, Washington, DC.

Activities of the Environmental Protection Agency Office of Radiation Programs during 1974 are summarized. Emphasis was placed on the implementation of a program leading to the establishment of necessary radiation controls for protection of public health and the environment. (CH)

7603 (UNI-SA—15) **Auditable program of compliance with ALAP.** Munson, L.H.; Freytag, L.A. (United Nuclear Industries, Inc., Richland, Wash. (USA)). 12 Nov 1975. Contract AT(45-1)-1857. 12p. (CONF-760202—15). Dep. NTIS $4.50.

From 9. topical symposium on operational health physics; Denver, Colorado, USA (9 Feb 1976).

Increasing public and governmental pressure is being felt by all sectors of the Nuclear Industry to demonstrate compliance to maintaining occupational radiation exposures as low as practicable (ALAP). This paper describes a systematic approach to occupational radiation exposure reduction which will not only reduce radiation exposure usage but will provide an auditable record of compliance with ALAP. The essential features of the program include guidelines for identification and appreciation of tasks which involve significant amounts of radiation exposure, the contribution of the Health Physicist in reducing radiation exposure, and a matrix for evaluation of feasibility, practicality, and economics of each application. (auth)

PHYSICS RESEARCH

ASTROPHYSICS AND COSMOLOGY

STARS

7604 (LA—6149-MS) **General numerical fluid dynamics algorithm for astrophysical applications.** Ruppel, H.M.; Cloutman, L.D. (Los Alamos Scientific Lab., N.Mex. (USA)). Oct 1975. Contract W-7405-ENG-36. 15p. Dep. NTIS $4.00.

Finite difference simulation of fluid flows under astrophysical conditions is often complicated by factors such as complex gas physics, the occurrence of dynamics at widely differing length scales, and the necessity of using implicit difference equations. This report describes a simple, general, and efficient algorithm for solving one-dimensional, spherically symmetric problems using a variation of the ICED-ALE method. A computer code named VEGA has been written based on this algorithm, and the early stages of the collapse of a one-solar mass protostellar cloud are presented as a sample solution. (auth)

PLANETARY PHENOMENA

7605 **Titius—Bode law and the possibility of recent large-scale evolution in the solar system.** Neito, M.M. (Los Alamos Scientific Lab., NM). *Icarus;* **25**: 171-174(1974).

Although it is by no means clear that the Titius—Bode law of planetary distances is indeed a "law" (even though there are enticing indications), it is proposed that if one assumes that the law is a "law" and that the planets obey it, then this argues against recent large-scale evolution in the solar system. Put another way: one can believe in the Titius—Bode law or in recent large-scale evolution or in neither of them. But it appears difficult to believe in both of them. (auth)

ATMOSPHERIC PHYSICS

AURORAL AND IONOSPHERIC PHENOMENA

7606 (LBL—4188) **Observation of the submillimeter cosmic background spectrum.** Woody, D.P. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 13 Nov 1975. Contract W-7405-ENG-48. 155p. Dep. NTIS $6.75.

Thesis.

An experimental measurement of the spectrum of the submillimeter cosmic background radiation is described. The experiment consists of measuring the night sky emission at an altitude of 39 km, correcting for the atmospheric molecular line emission, and placing limits on the contamination from sources of continuum radiation such as the apparatus itself and the earth. The observations were made on 24 July 1974 using a fully calibrated liquid-helium-cooled balloon-borne spectrophotometer. Important features of the apparatus include a cooled antenna, a polarizing interferometer, and a germanium bolometric detector. The characterization of the spectrophotometer includes the large angle response and emission of the antenna. The calibration of the instrument and corrections to the observed sky spectrum are based on measurements made during the flight. A simple model of the molecular line emission is used to determine the atmospheric contribution. The resulting spectrum covers the frequency range from 4 to 17 cm^{-1} and establishes that the cosmic background radiation follows the high frequency quantum cutoff for a 3K blackbody. A blackbody temperature of 2.99/sub $-.14/^{+.07}$/K is deduced from our data. The present status of the cosmic background observations, which span more than three decades in frequency, is analyzed and it is concluded that they are all consistent with a blackbody temperature of 2.90 +- .04K (+- 1 SIGMA). This firmly supports the Big Bang cosmological model of the universe. (auth)

ATOMIC, MOLECULAR, AND CHEMICAL PHYSICS

BEAMS AND THEIR REACTIONS

7607 (CONF-741040—P1, pp 86-96) **Investigation of reordered (001) Au surfaces by positive ion channeling spectroscopy, LEED and AES.** Appleton, B.R.; Noggle, T.S.; Miller, J.W.; Schow, O.E. III; Zehner, D.M.; Jenkins, L.H.; Barrett, J.H. (Oak Ridge National Lab., TN). 1974.

From 3. conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In Proceedings of the third conference on application of small accelerators. Volume I. The use of small accelerators in research and teaching.

As a consequence of the channeling phenomenon of positive ions in single crystals, the yield of ions Rutherford scattered from an oriented single crystal surface is dependent on the density of surface atoms exposed to the incident ion beam. Thus, the positive ion channeling spectroscopy (PICS) technique should provide a useful tool for studying reordered surfaces. This possibility was explored by examining the surfaces of epitaxially grown thin Au single crystals with the combined techniques of LEED-AES and PICS. The LEED and AES investigations showed that when the (001) surface was sputter cleaned in ultra-high vacuum, the normal (1 x 1) symmetry of the (001) surfaces reordered into a structure which gave a complex (5 x 20) LEED pattern. The yield and energy distributions of 1 MeV He ions scattered from the Au surfaces were used to determine the number of effective monolayers contributing to the normal and reordered surfaces. These combined measurements were used to characterize the nature of the reordered surface. The general applicability of the PICS technique for investigations of surface and near surface regions is discussed. (auth)

7608 (CONF-741040—P1, pp 132-138) **Sites of Au atoms in Sn crystals as determined by channeling.** Miller, J.W.; Gemmell, D.S.; Holland, R.E.; Poizat, J.C.; Worthington, J.N.; Loess, R.E. (Argonne National Lab., IL). 1974.

From 3. conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In Proceedings of the third conference on application of small accelerators. Volume I. The use of small accelerators in research and teaching.

The position of Au atoms diffused into Sn monocrystals has been studied by channeling and backscattering of 2.5-MeV Ne ions. For equilibrium conditions at 217°C, Au atoms are found almost entirely in substitutional positions, so that the unusually fast diffusion of Au in Sn most likely arises from a small fraction of Au atoms migrating interstitially. (auth)

7609 (CONF-750965—1) **Dechanneling measurements of defect depth profiles and effective cross-channel distribution of misaligned atoms in ion irradiated gold.** Pronko, P.P. (Argonne National Lab., Ill. (USA)). 1975. Contract W-31-109-Eng-38. 27p. Dep. NTIS $4.50.

From International conference on atomic collisions in solids; Amsterdam, Netherlands (22 Sep 1975).

Defect depth profiles for self ion and He^+ irradiated gold are obtained from single and multiple scatter dechanneling analysis in single crystal gold films. Quantitative defect densities are obtained through use of atomic scattering cross sections. Integral damage profiles are extracted from the dechanneling spectra and subsequently differentiated to yield the volume concentration of defects as a function of depth. Results from the self ion irradiations suggest that incident ions produce defect distributions across depths much greater than predicted by random stopping theory. This is in agreement with TEM observations of others. Comparison of the experimental profiles is made with theoretical vacancy distributions predicted by defect diffusion in a radiation environment. Similarities are observed for the low fluence irradiations suggesting that profile characteristics may be controlled by rapid migration and loss of interstitials to the film surfaces during irradiation. Information on the across-channel distribution of misaligned atoms in the damaged films is obtained with the steady increase of transverse energy model applied to the dechanneling spectra. A predominance of slight misalignment is observed with no contribution to dechanneling coming from atoms displaced significantly close to the center of the channels. This is in keeping with what is expected for crystal distortions caused by the strain fields associated with vacancy cluster defects. (auth)

7610 (CONF-750975—7) **Extreme ultraviolet spectra of highly stripped silicon ions.** Griffin, P.M.; Pegg, D.J.; Selling, I.A.; Jones, K.W.; Pisano, D.J.; Kruse, T.H.; Bashkin, S. (Oak Ridge National Lab., Tenn. (USA)). 1975. 9p. Dep. NTIS $4.50.

From 4. international conference on beam-foil spectroscopy; Gatlinburg, Tennessee, USA (15 Sep 1975).

A study of foil-excited spectra in the wavelength range 107-374 Angstroms from highly stripped Si ions is reported. Many of the lines that have been identified are associated with $\Delta n = 0$ transitions in Si VI-Si XI of the type 2s²2p/sup k/-2s2p/sup k + 1/ or 2s2p/sup k/-2p/sup k + 1/. 2 figures, 1 table (GHT)

7611 (ORO—2591-75) **Formation of excited hydrogen atoms by charge transfer and dissociation. Progress report No. 11, December 1, 1974—November 1, 1975.** Thomas, E.W.; Zivitz, M.; Rausch, E.O.; Baird, W.E.; Harris, J.E. (Georgia Inst. of Tech., Atlanta (USA). School of Physics). 1 Nov 1975. Contract AT(40-1)-2591. 79p. Dep. NTIS $6.00.

A study of the excited states of atoms backscattered from metal surfaces is presented. Incident ions were H^+, H_2^+, and He^+ at energies of 10 to 30 keV. Preliminary data are presented for a study of the charge state distribution among atoms backscattered from surfaces. Results of a study of light emission from atoms sputtered off targets by 10 to 30 keV Ar^+ ions as a way to determine surface contamination are presented. Brief studies of radiation damage by 10 to 30 keV H^+ and He^+ ions are discussed. 5 figures. (GHT)

7612 (UCRL—77310) **Measurement of x-rays emitted from projectiles moving in solid targets.** Fortner, R.J.; Matthews, D.L.; Feldman, L.C.; Garcia, J.D.; Oona, H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1975. 10p. (CONF-750975—5). Dep. NTIS $4.50.

From 4. international conference on beam-foil spectroscopy; Gatlinburg, Tennessee, USA (15 Sep 1975).

The results of three separate experiments all dealing with the production of x-rays in projectiles moving in solids are discussed. The first experiment deals with the measurement of line widths of x-rays emitted from projectiles moving in solid targets. The effect of collisional broadening of x-rays is found to dominate the line widths giving greater than an order of magnitude increase in the measured line widths. The second experiment studies "solid target effects" in producing non-binomial distributions of characteristic K x-ray spectra in heavy ion-atom collisions. The third experiment studies aluminum K x-ray production in Ar^+ yields Al collisions in very thin aluminum foils as a function of foil thickness. Parameterization of the observed non-linear dependence enables the lifetime of the argon 2p vacancy and total ionization cross sections for the argon L-shell in Ar yields Al collisions to be measured. (auth)

7613 **Energy spreading and angular distribution of a beam of electrons in molecular hydrogen.** Heaps, M.G.; Green, A.E.S. (University of Florida, Gainesville, Florida 32611). *J. Appl. Phys.;* **46**: No. 11, 4718-4725(Nov 1975).

A Monte Carlo approach is used to obtain the energy spreading and angular distribution of initially monoenergetic and monodirectional beams of electrons incident on a gas of molecular hydrogen. Several beams of primary electrons and the resultant secondaries are degraded in a step-by-step procedure which utilizes a detailed set of cross sections, together with reasonable approximations for the creation of secondary electrons. Particular attention is paid to the initial angular distribution of secondary electrons. An analytic function which characterizes current experimental differential cross-section data is used to provide realistic inputs into our calculations. The results for energy distribution as a function of distance and angular distribution at selected energies and distances are illustrated. (AIP)

7614 **Temperature dependence of transmission proton channeling in Ag.** Berliner, R.; Koehler, J.S. (Department of Physics and Materials Research Laboratory, University of Illinois, Urbana, Illinois 61801). *Phys. Rev., B;* **12**: No. 9, 3559-3574(1 Nov 1975).

Channeling measurements have been made on four Ag single crystals at T = 300 K, T = 90 K, and T = 20 K in the transmission configuration with 1-MeV protons. Effects due to temperature, crystal thickness, and crystal perfection were investigated through the use of large-angle (45°) Rutherford scattering and small-angle transmitted intensity and energy measurements. The majority of the measurements were for the <100> axis but some measurements were also performed on the <110> axis. The results for the temperature dependence of $\psi_1/_2(<100>)$ (the angular half-width) and the channeling minimum yield agree well with the theoretical expectations and show effects due to crystal thickness and imperfections. The transmission measurements of the channeled-particle stopping power provide a spread in the values for β (the ratio of the energy loss for channeled particles to that for random particles) from 0.43 to 0.75 primarily owing to variations in specimen perfection. A study of the exit-particle energy distributions for various crystal positions near the <100> axis correlates with the transmitted particle intensity distribution data and

is in qualitative agreement with the E/sub perpendicular/ diffusion model of dechanneling. (AIP)

7615 Slowing-down time of energetic ions in solids. Oen, O.S.; Robinson, M.T. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *J. Appl. Phys.*; **46**: No. 12, 5069-5071(Dec 1975).

The average time required for an energetic ion or primary knock-on atom to slow down in a structureless solid has been calculated using a Thomas-Fermi interaction potential and electronic stopping power which is proportional to the velocity. The relevance of this time to radiation damage production is discussed. (AIP)

ATOMIC AND MOLECULAR PROPERTIES

7616 (ANL—75-75, pp 206-208) **High-resolution study of photoionization in H_2, HD, and D_2.** Chupka, W.A.; Dehmer, P.M.; Jivery, W.T. 1975.

In Physics Division annual review, 1 April 1974—31 March 1975.

7617 (ANL—75-75, pp 209-211) **High-resolution photoionization study of ion-pair formation in H_2, HD, and D_2.** Chupka, W.A.; Dehmer, P.M.; Jivery, W.T. 1975.

In Physics Division annual review, 1 April 1974—31 March 1975.

7618 (ANL—75-75, pp 237-240) **Laser spectroscopy of actinide molecules.** Childs, W.J.; Goodman, L.S. 1975.

In Physics Division annual review, 1 April 1974—31 March 1975.

7619 (BNL—20626) **Theory of singlet-doublet excitations in praseodymium.** Bak, P. (Brookhaven National Lab., Upton, N.Y. (USA)). Oct 1975. 5p. (CONF-751209—13). Dep. NTIS $4.50.

From 21. annual conference on magnetism and magnetic materials; Philadelphia, Pennsylvania, USA (9 Dec 1975).

The magnetic excitation spectrum in a paramagnetic singlet-doublet system is calculated using a diagrammatic high densit, expansion technique. The lowest order diagrams, which correspond to the random phase approximation (RPA), give a detailed description of the wave vector and temperature dependence of the four exciton modes in praseodymium in terms of a Hamiltonian including isotropic Heisenberg exchange interactions and anisotropic, dipolar-like interactions. The leading contributions to the linewidths of the excitations are obtained by extending the 1/Z expansion of the generalized susceptibility propagators one order beyond the random phase approximation. This damping corresponds to spin wave scattering on single-site fluctuations. The theoretical spectral functions are in detailed agreement with experiment. (auth)

7620 (CONF-750975—9) **Autoionizing states in highly ionized oxygen, fluorine and silicon.** Forester, J.P.; Peterson, R.S.; Griffin, P.M.; Pegg, D.J.; Haselton, H.H.; Liao, K.H.; Sellin, I.A.; Mowat, J.R.; Thoe, R.S. (Tennessee Univ., Knoxville (USA); Oak Ridge National Lab., Tenn. (USA)). 1975. 9p. Dep. NTIS $4.50.

From 4. international conference on beam-foil spectroscopy; Gatlinburg, Tennessee, USA (15 Sep 1975).

Autoionizing states in high Z 3-electron ions associated with core excited configurations of the type 1s2snl and 1s2pnl are reported. The electron decay-in-flight spectra of lithium-like oxygen, fluorine, and silicon ions are presented. Initial beam energies of 6.75-MeV oxygen and fluorine ions and 22.5-MeV silicon ions were used. Stripping and excitation were done by passing the beams through a thin carbon foil. The experimental technique is described. 4 figs, 1 table, 7 refs. (GHT)

7621 (LBL—3401) **Infrared spectrum of curium-244.** Conway, J.G.; Blaise, J.; Verges, J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1974. Contract W-7405-ENG-48. 58p. Dep. NTIS $4.50.

The spectrum of curium-244 has been observed on the high resolution Fourier-transform spectrometer at Laboratoire Aime Cotton. An electrodeless lamp containing 50 μg of CmI_3 was run for 12 hours and 800,000 points were taken. A total of 1743 lines have been ascribed to curium and 87 percent of the lines have been assigned to transitions between known energy levels.

7622 (LBL—3876) **Lamb shift in hydrogenlike ions.** Mohr, P.J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 11 Nov 1975. Contract W-7405-ENG-48. 9p. (CONF-750975—11). Dep. NTIS $4.50.

From 4. international conference on beam-foil spectroscopy; Gatlinburg, Tennessee, USA (15 Sep 1975).

Experimental and theoretical values for the Lamb shift in hydrogen and in hydrogenic atoms are presented. 3 tables, 32 references. (GHT)

7623 (LBL—4000, pp 325-327) **Multiplet splitting of the 4s and 5s core levels in the rare earth metals.** McFeely, F.R.; Kowalczyk, S.P.; Ley, L.; Shirley, D.A. Jul 1975.

In Nuclear chemistry. Annual report, 1974.

7624 Nature of the chemical bond: an energetic view. Ruedenberg, K. (Univ., Bonn). pp 223-245 of In Localization and delocalization in quantum chemistry. Vol. I. Chalvet, O. (ed.). Dordrecht, Netherlands; D. Reidel Publishing Co. (1975).

The energy of the hydrogen molecule ion system is analyzed for all internuclear distances in order to understand why it is lower at the distance of two Bohr radii (the equilibrium distance) than at infinite separation. The peculiar behavior of the kinetic and potential binding energies as functions of the internuclear distance is elucidated by resolving these curves into additive superpositions of five contributions which are simple functions of the internuclear distance. The quantitative behavior of these contributions is straightforwardly explained in terms of physical interactions and through an examination of the variational process. The analysis leads to the interpretative concepts of promotion, interference and quasiclassical electrostatic interactions, and it identifies those effects which are essential for the formation of the chemical bond in H_2+. The covalent bond is shown to arise from delocalization through electron sharing. (auth)

7625 Unified treatment of perturbed series, continuous spectra and collisions. Fano, U. (Univ. of Chicago). *J. Opt. Soc. Am.*; **65**: No. 9, 979-987(Sep 1975).

The properties of entire spectra—specifically, the line positions and transition probabilities of perturbed series and of their adjoining continua as well as autoionization line profiles and related collision cross sections—have been interpreted in terms of a few parameters, such as quantum defects and oscillator-strength densities, which vary slowly with the excitation energy. By use of Seaton's quantum-defect theory, the concept of separate configurations is replaced by the more comprehensive concept of channels. Alternative sets of channels are considered, related by a frame transformation whose construction is a main goal of the analysis of each spectrum. Concepts and procedures employed for these purposes since 1969 are summarized and restated here. Reference is made to extension of the treatment to negative ions, and to the direct ab initio calculation of the channel parameters to be compared with experimental results. Illustrative results are presented, as well as a guide to relevant literature. (auth)

7626 Ne—H—H potential energy surface including electron correlation. Birks, J.W.; Johnston, H.S.; Schaefer, H.F. III. (Univ. of California, Berkeley). *J. Chem. Phys.*; **63**: No. 5, 1741-1747(1 Sep 1975).

An ab initio calculation of the Ne—H—H potential energy hypersurface for a wide range of H_2 internuclear separation (0.8 less than or equal to R less than or equal to 5.0 bohr) and Ne—H_2 separation (2.5 less than or equal to X less than or equal to 6.0 bohr) is reported. Calculations were carried out for both the collinear and perpendicular bisector geometries. For the perpendicular bisector geometry, the potential surface has the property previously found for He—H_2 of exerting a contractive force on the H_2 molecule as the noble gas atom approaches. The surface demonstrates a crossover point near 3.0 bohr where the contractive force changes to a stretching force. Analytic fits to the potential energy surface are presented and discussed in detail. In particular, the "dumbbell" model was not found to provide a good description of the potential surface. Because of the wide range in values of X and R for which points were calculated, the surface reported here should be useful for trajectory studies of diatomic dissociation and atom recombination. (auth)

7627 Raman spectra and defect fluorescence of anthrancene and naphthalene crystals at high pressure and low temperatures. Nicol, M.; Vernon, M.; Woo, J.T. (Univ. of California, Los Angeles). *J. Chem. Phys.*; **63**: No. 5, 1992-1999(1 Sep 1975).

Raman spectra of the lattice modes of crystalline anthracene and naphthalene have been measured at pressures to 36 kbar at several temperatures from 450°K to below 30°K. The Raman shifts of the lattice modes of anthracene increase significantly (10—20 cm^{-1}) upon isobaric cooling from room to liquid helium temperatures at pressures below 10 kbar; at higher pressures, the Raman shifts of these modes change by less than 5 cm^{-1} upon cooling. For naphthalene, the smaller temperature dependence was observed even at 5 kbar, the lowest pressure studied. The naphthalene results agree well with observations to 10 kbar reported by Dows et al.; however, the anthracene results more

closely correspond to the observations reported by Wong and Whalley, whose measurements also extend to pressures greater than 10 kbar. No evidence of a phase transformation to naphthalene II was observed even when a crystal had been maintained at 30 kbar and 425°K for more than 24 h. At pressures greater than 17 kbar for anthracene and 30 kbar for naphthalene, an excimerlike fluorescence of defects in the melt-grown crystals was directly excited by the argon laser at 514.5 nm and dominated the Raman spectra. The anthracene defect fluorescence could be excited with 457.9 nm radiation at all pressures and changed from a banded to a predominately broad structureless spectrum at less than 1 kbar; however, Raman spectra of anthracene at high pressures excited with 632.9 nm were characteristic of a compressed atmospheric-pressure structure. No additional features characteristic of a dimer defect could be detected in the Raman spectra of anthracene crystals that had been held at 30 kbar and irradiated with ~100 mW of 363.8 nm radiation for as long as 8h. (auth)

7628 Independent-particle-model potentials for atoms and ions with 36 less than Z less than or equal to 54 and a modified Thomas—Fermi atomic energy formula. Garvey, R.H.; Jackman, C.H.; Green, A.E.S. (Univ. of Florida, Gainesville). *Phys. Rev., A;* 12: No. 4, 1144-1152(Oct 1975).

Using the ab initio energy-minimization procedure of Bass, Green, and Wood, two potential parameters, xi and eta are determined, characterizing the independent-particle-model potential of Green, Sellin, and Zachor (GSZ) for atoms and positive ions with 36 less than Z less than or equal to 54. This extends earlier modified-Hartree—Fock (MHF) calculations of Szydlik and Green and of Green, Garvey, and Jackman. It is found that both of the parameters in question display, to a good approximation, a linear dependence on the degree of ionization Z—N for fixed numbers of electrons N. The slopes and y intercepts associated with the linear dependence of xi display marked shell-like behavior, while those associated with eta vary rather smoothly with N. The determinations of total energies are usually within 50 ppm of earlier Hartree—Fock calculations for those cases in which such calculations exist. Using the entire collection of energies and GSZ minimization parameters now available, a modified version of the Thomas—Fermi statistical model (MTF) due to Green, Sellin, and Darewych is reexamined. This model is shown to be capable of yielding the linear Z—N dependence of the GSZ parameters which were found empirically in the MHF work. By numerical adjustment of the coefficients of our MTF model, energies of stable atoms and ions, as well as GSZ potential parameters which are in good agreement with the MHF calculations are obtained. 3 tables, 4 figures. (auth)

7629 Low-energy (less than or equal to 3 eV) electron attachment to molecules in very-high pressure gases: C_2H_5Br. Goans, R.E.; Christophorou, L.G. (Oak Ridge National Lab., TN). *J. Chem. Phys.;* 63: No. 7, 2821-2827(1 Oct 1975).

Significant changes have been observed in both the magnitude and the energy dependence of the rate of attachment of slow (approximately equal to 3 eV) electrons to bromoethane (C_2H_5Br) in either N_2 or Ar gases with increasing density of these media from 500 to 25,000 torr for N_2 and from 500 to 42,000 torr for Ar. The observed density and energy dependences of the attachment rates are discussed on the basis of two plausible reaction schemes involving either one or two states of $C_2H_5Br^-$. On the basis of the one-state reaction scheme, determinations were made of the absolute rate of formation of $C_2H_5Br^{-*}$ and of the relative magnitudes of the rates for dissociation and autoionization of the metastable $C_2H_5Br^{-*}$ ion as a function of the mean electron energy (ϵ). On the basis of the same reaction scheme, the lifetime of $C_2H_5Br^*$ was estimated to be greater than or equal to13 psec in the mean energy range 0.3—1 eV. Although the vertical attachment energy for the C_2H_5Br molecule is ~0.75 eV, the present results imply that its adiabatic electron affinity is positive (>0 eV). (auth)

7630 Properties of solid and gaseous hydrogen, based upon anisotropic pair interactions. Etters, R.D. (Colorado State Univ., Fort Collins); Danilowicz, R.; England, W. *Phys. Rev., A;* 12: No. 5, 2199-2212(Nov 1975).

Properties of H_2 are investigated using an analytic anisotropic potential which has been deduced from recent atomic orbital and perturbation calculations. The low-pressure solid results are based upon a spherical average of the anisotropic potential. The calculated ground-state energy is $E_0 = -88.76 +- 2$ K. The pressure-volume curve agrees with experiment to within 10 percent over the range 9 less than or equal to V less than or equal to 22.65 cm^3/mole H_2. The high-pressure solid properties are calculated using the anisotropic potential for particular frozen orientations, as well as the spherically averaged potential. The structures investigated are the P/sub a/3 and $P4_2$/mnm orientations. The $P4_2$/mnm orientation yields energies and pressures 10-20 percent lower than either the spherical average or the P/sub a/3 arrangement. Agreement with experimental shock-wave data is tolerable. The metal-insulator phase-transition pressure is predicted to be between 1.61×10^6 and 3.76×10^6 atm, depending on the metallic equation of state used. Second virial coefficients B(T) are calculated for H_2 and D_2 over the range 60 K less than or equal to T less than or equal to 523 K, using a formation which fully accounts for the potential anisotropies and the discrete rotational spectrum. The results are in excellent agreement with experiment except at high temperatures, where the discrepancy is nearly 10 percent. A comparison of the results with those obtained using the spherically averaged potential indicates that the effect of anisotropies on B(T) is small. This coupled with the results from solid calculations implies that anisotropies are generally not very important except at extremely high pressures. The difference in B(T) between ortho and para H_2 and D_2 is also calculated. (auth)

7631 Wavelength dependence of the photoelectron angular distributions of the rare gases. Dehmer, J.L.; Chupka, W.A.; Berkowitz, J.; Jivery, W.T. (Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev., A;* 12: No. 5, 1966-1973(Nov 1975).

Photoelectron angular distributions for the valence p shells of the rare gases have been measured up to a photon energy of 40.8 eV (48.4 eV for Ne) using resonance radiation from a hollow-cathode discharge lamp. This work extends the range of existing absolute measurements on Ne, Kr, and Xe. Comparison with Hartree-Fock and RPAE (random-phase approximation with exchange) calculations indicates excellent agreement for Ne. However, the present results, particularly for Xe, add to earlier evidence that data for Ar, Kr, and Xe show systematic deviations from theory, especially at the higher photoelectron kinetic energies. For Kr and Xe, we report asymmetry parameters separately for processes leading to the $^2P_{3/2,1/2}$ spin-orbit states of the residual ion. The Xe results indicate that $\beta_{3/2} - \beta_{1/2}$ is positive for $\lambda >$ or = 461 A, but changes sign in the range $\lambda \sim$ 350—400 A. At 304 A, $\beta_{3/2} - \beta_{1/2} = -0.30$, which agrees with a recent calculation based on the Dirac-Slater model. (AIP)

7632 High resolution photoionization study of ion-pair formation in H_2, HD, and D_2 . Chupka, W.A.; Dehmer, P.M.; Jivery, W.T. (Argonne National Laboratory, Argonne, Illinois 60439). *J. Chem. Phys.;* 63: No. 9, 3929-3944(1 Nov 1975).

A new photoionization mass spectrometer which is significantly superior to previous instruments in both wavelength resolution and ion intensity is described. It has been used in the study of photon-induced ion-pair formation at 78° K in para-H_2, ordinary H_2 and D_2 (the ortho-para equilibrium mixtures), and HD in the wavelength region from 718 to 700 A, at a wavelength resolution (FWHM) of 0.035 A for para-H_2, 0.07 A for ordinary H_2 and D_2, and 0.15 A for HD. The threshold for formation of ion pairs from para-H_2 is used with the accurately known values of the dissociation energy of H_2 and the ionization potential of atomic hydrogen to find a value of the electron affinity of the hydrogen atom of 0.754 eV in excellent agreement with the theoretical value of 0.75421 eV calculated by Pekeris. The observed thresholds for ion-pair formation in D_2 and HD are also in excellent agreement with the calculated positions. For para-H_2 the region within 0.5 A of the threshold has a continuumlike appearance contains window resonances which are interpreted as predissociating members of a Rydberg series converging to H_2^+(v=9, N=2). The continuum results from closely spaced predissociating Rydberg states converging to H_2^+(v=9 N=0). A number of other tentative Rydberg state assignments were made for para-H_2 based on the results of an analysis using multichannel quantum defect theory. For HD, the H^-/D^- ratio is ~ 2 just above threshold and appears to decrease with decreasing wavelength; however, this is due, at least in part, to discrimination by the detection system against the more energetic H^- ions. Some conclusions and inferences regarding the mechanism for predissociation in H_2 and HD are discussed, particularly the possible importance of the $4f\sigma\ ^1\Sigma^+$/sub u/ state. (AIP)

7633 Relation between charge and force parameters of closed-shell atoms and ions. Gilbert, T.L.; Simpson, O.C.; Williamson, M.A. (Argonne National Laboratory, Argonne, Illinois 60439). *J. Chem. Phys.;* 63: No. 9, 4061-4071(1 Nov 1975).

Combining rules for parameters which characterize the short-range repulsive forces between closed-shell atoms and ions are used to determine the radius and softness for a number of alkali and halide ions and rare-gas atoms from scattering and spectroscopic data. A corresponding set of charge radii and softnesses are determined from atomic charge densities calculated in both the relativistic and nonrelativistic Hartree—Fock approximations. These characteristic atomic parameters are compared, and it is found that, for species with the same charge belonging to the same column of the periodic table, the relations between charge and force radii and between charge and force softnesses are very

nearly linear. The radial distance dependence of the softness is examined, and some areas where further work is needed to follow up this empirical study are indicated. (AIP)

POSITRONIUM, MUONIUM, AND MUONIC AND MESIC ATOMS AND MOLECULES

7634 (BNL—20527) **Positron annihilation in perfect and imperfect metals: a brief review.** Goland, A.N. (Brookhaven National Lab., Upton, N.Y. (USA)). 1975. 18p. (CONF-751006—9). Dep. NTIS $4.50.

From International conference on radiation damage in metals; Gatlinburg, Tennessee, USA (5 Oct 1975).

The current renaissance of investigations of positron annihilation in solids has its origins in the observation that positrons interact strongly with certain crystal-lattice defects. Three properties of the annihilation process are being measured to gain information about the defects or about the local environment of the positron at the instant of its annihilation: positron lifetime, angular correlation of the two annihilation quanta, and Doppler broadening of the 511-keV annihilation line. Until the physics of positron behavior in solids is fully understood, the phenomenon will continue to be useful in a manner analogous to electrical resistivity recovery for identifying the recovery stages in irradiated metals. Ultimately, it is destined to provide detailed quantitative information such as the formation volume of vacancies, vacancy-impurity binding energies and electron momentum distributions and densities at defect sites. 2 tables, 52 refs. (auth)

7635 (LA—6073-MS) **Higher order corrections to energy levels of muonic atoms.** Rinker, G.A. Jr.; Steffen, R.M. (Los Alamos Scientific Lab., N.Mex. (USA)). Aug 1975. Contract W-7405-ENG-36. 23p. Dep. NTIS $4.00.

In order to facilitate the analysis of muonic x-ray spectra, the results of numerical computations of all higher order quantum electrodynamical corrections to the energy levels of muonic atoms are presented in tabular and graphical form. These corrections include the vacuum polarization corrections caused by emission and reabsorption of virtual electron pairs to all orders, including "double-bubble" and "cracked-egg" diagrams. An estimate of the Delbruecke scattering-type correction is presented. The Lamb-shift (second- and fourth-order vertex) corrections have been calculated including the correction for the anomalous magnetic moment of the muon. The relativistic nuclear motion (or recoil) correction as well as the correction caused by the screening of the atomic electrons is presented in graphs. For the sake of completeness a graph of the nuclear polarization as computed on the basis of Chen's approach has been included. All calculations were made with a two-parameter Fermi distribution of the nuclear charge density. 7 figures, 23 references. (auth)

7636 (LBL—4608) **μ^+SR spectroscopy: the positive muon as a magnetic probe in solids.** Brewer, J.H.; Fleming, D.G.; Crowe, K.M.; Johnson, R.F.; Patterson, B.D.; Portis, A.M.; Gygax, F.N.; Schenck, A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1974. Contract W-7405-ENG-48. 22p. (CONF-740633—10). Dep. NTIS $4.50.

From International conference on hyperfine interactions studied in nuclear reactions and decay; Uppsala, Sweden (10 Jun 1974).

Through its asymmetric decay, the positive muon acts as a sensitive detector of the interactions of its spin with the medium in which it comes to rest. Development of the μ^+SR spectroscopy technique is described, and recent applications of the μ^+ as a probe are discussed. Results for hyperfine fields in ferromagnets and impurity states in nonmetals are presented with suggestions for future studies. 6 figures. (auth)

7637 **Sufficient conditions for objective local theories.** Edwards, J. (Simon Fraser Univ., Burnaby, B. C.). *Nuovo Cim., B;* **29B**: No. 1, 100-104(11 Sep 1975).

It is known that all objective local theories for systems containing two photons must satisfy a generalized Bell inequality. It is shown by specific counter-example that satisfaction of the generalized Bell inequality is not a sufficient condition for the two-photon system formed in the decay of singlet positronium to be described in terms of an objective local theory. (auth)

COLLISION PHENOMENA

7638 (ANL—75-75, pp 213-216) **Photoionization study of the reaction of O^+_2(a^{4}Pi/sub u/) with O_2.** Dehmer, P.M.; Chupka, W.A.; Jivery, W.T. 1975.

In Physics Division annual review, 1 April 1974—31 March 1975.

7639 (CONF-741040—P1, pp 120-131) **Auger electron spectroscopy applied to inner shell ionization by fast charged particles.** Toburen, L.H. (Battelle Pacific Northwest Lab., Richland, WA). 1974.

From 3. conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In Proceedings of the third conference on application of small accelerators. Volume I. The use of small accelerators in research and teaching.

Until recently, inner shell ionization by charged particle impact was studied almost exclusively through the use of x-ray spectroscopy. This method is limited in accuracy, however, for ionization of inner shells where the fluorescence yield is small. For K-shell ionization of elements with atomic number less than about ten the fluorescence yield can be considered negligible and Auger electron emission cross section provide direct information regarding the ionization cross section. The ionization cross sections determined in this way are accurate to approximately 20 percent whereas x-ray measurements may be uncertain by a factor of five or more due to uncertainties in fluorescence yields. In addition to ionization cross sections, Auger emission spectra provide information regarding multiple ionization, effects of molecular binding on inner shell ionization and, when coupled with x-ray measurements, provide fluorescence yields as a function of the final state of the target atom. These points will be illustrated for ionization by fast protons along with some results for heavier incident particles. (auth)

7640 (CONF-741040—P1, pp 402-409) **X-ray production in heavy ion-atom collisions: 4fσ electron promotion.** Fortner, R.J. (Univ. of California, Livermore). 1974.

From 3. conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In Proceedings of the third conference on application of small accelerators. Volume I. The use of small accelerators in research and teaching.

A systematic study is made of x-ray production in ion-atom collisions for electron promotion by 4f sigma molecular orbitals. L x-ray production cross sections are presented for P^+, S^+, Cl^+, Ar^+ and K^+ projectiles incident on Ar gas targets for projectile energies between 15 and 200 keV. In addition, high resolution L x-ray spectral measurements for Ar^+yields Ar collisions are presented. Average values of the fluorescence yield and total L-shell ionization cross sections are determined. A dramatic Z dependence observed in the x-ray production cross section is attributed to changes in fluorescence yield. New theoretical calculations of argon L fluorescence yield are found to be in reasonable agreement with the experiment for the Ar^+ yields Ar case. (auth)

7641 (CONF-741040—P1, pp 419-426) **K-shell fluorescent yields for multiply-ionized neon.** Moore, C.F. (Univ. of Texas, Austin); Matthews, D.L. 1974.

From 3. conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In Proceedings of the third conference on application of small accelerators. Volume I. The use of small accelerators in research and teaching.

The use of small accelerators for the production of Auger electrons and x-rays from heavy ion collisions with neon is discussed. High resolution measurements of both K x-rays and K Auger electrons are used to deduce the fluorescent yields for neon singly ionized in the K shell and multiply ionized (ith degree) in the L shell. As an example, the fluorescence yields of 0^{+9} bombardment are found to be anti ω/sub i/ (x 100) = 1.6, 1.7, 1.9, 2.3, 3.9, 7.5 and 23.0 for i = 0 yields 6 respectively. The ω/sub i/ for high charge states are found to be approximately 2 times larger than that theoretically predicted. Recent improved theoretical calculations which assume a statistical distribution of the possible multiplet states for a given L shell vacancy appear to resolve the discrepancy. (auth)

7642 (CONF-741040—P1, pp 427-435) **Impact parameter dependence of inner-shell ionization probabilities.** Cocke, C.L. (Kansas State Univ., Manhattan). 1974.

From 3. conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In Proceedings of the third conference on application of small accelerators. Volume I. The use of small accelerators in research and teaching.

The probability for ionization of an inner shell of a target atom by a heavy charged projectile is a sensitive function of the impact parameter characterizing the collision. This probability can be measured experimentally by detecting the x-ray resulting from radiative filling of the inner shell in coincidence with the projectile scattered at a determined angle, and by using the scattering angle to deduce the impact parameter. It is conjectured that the functional dependence of the ionization probability may be a more sen-

sitive probe of the ionization mechanism than is a total cross section measurement. Experimental results for the K-shell ionization of both solid and gas targets by oxygen, carbon and fluorine projectiles in the MeV/amu energy range will be presented, and their use in illuminating the inelastic collision process discussed. (auth)

7643 (CONF-750820—1) **Theoretical aspects of electron correlations in electron collisions.** Inokuti, M. (Argonne National Lab., Ill. (USA)). 1975. Contract W-31-109-Eng-38. 21p. Dep. NTIS $4.50.

From Conference on photoionization and other probes of many-electron interactions; Carry-le-Rouet, France (31 Aug 1975).

Electron-correlation effects manifest themselves in diverse facets of electron collisions with an atom or molecule. A fast incident electron acts largely as an external agent, and its inelastic collisions probe the structure, including correlations within the target (in both the initial state and the final state), nearly in the same way as photoionization processes do. In inelastic collisions of a slow electron, the central object of study is the correlated motion of the incident electron and an electron excited out of the target core. This elementary observation is illustrated in the lecture by many examples and is elaborated by remarks on some current theoretical methods. (auth)

7644 (CONF-750965—3) **Some new effects seen in the passage of swift ion clusters through solids.** Gemmell, D.S.; Remillieux, J.; Poizat, J.C.; Gaillard, M.J.; Holland, R.E.; Vager, Z. (Argonne National Lab., Ill. (USA)). 1975. Contract W-31-109-Eng-38. 25p. Dep. NTIS $4.50.

From International conference on atomic collisions in solids; Amsterdam, Netherlands (22 Sep 1975).

Distributions in angle and in energy have been measured for ions transmitted through thin solid targets bombarded by various molecular-ion beams. The results, which differ markedly from those expected on the basis only of a simple "Coulomb explosion," indicate the existence of an additional force tending to align the internuclear vectors of each cluster with the beam direction. An explanation is suggested in terms of a potential attributable to the plasma oscillations generated by the particles as they traverse the solid. Calculations are presented to substantiate this idea. (auth)

7645 (CONF-750975—2) **Multiple electron loss cross sections for 60 MeV I^{+10} in single collisions with xenon.** Bridwell, L.B.; Biggerstaff, J.A.; Alton, G.D.; Jones, C.M.; Miller, P.D.; Kessel, Q.; Wehring, B.W. (Murray State Univ., Ky. (USA)). 1975. 8p. Dep. NTIS $4.00.

From 4. international conference on beam-foil spectroscopy; Gatlinburg, Tennessee, USA (15 Sep 1975).

Single scattering events of 60 MeV I^{10+} ins and Xe target atoms were observed to obtain cross sections for the loss of several electrons in a single collision. The experimental apparatus is described, and results are shown for charge state distributions at two Xe gas cell pressures and differential scattering cross sections for single collision electron removal at three different angles. 3 figures, 1 table (GHT)

7646 (CONF-750975—6) **Autoionizing states in the alkalis.** Pegg, D.J. (Tennessee Univ., Knoxville (USA); Oak Ridge National Lab., Tenn. (USA)). 1975. 16p. Dep. NTIS $4.50.

From 4. international conference on beam-foil spectroscopy; Gatlinburg, Tennessee, USA (15 Sep 1975).

Autoionization measurements are presented for collisionally excited states of lithium, sodium, magnesium, and potassium. Excitation was accomplished by passing a 70 keV beam of the alkali ions through a gas cell containing helium. Details of the experimental apparatus are given and electron spectra of the excited atoms are shown. 6 figs, 4 tables, 26 refs (GHT)

7647 (CONF-750975—8) **Angular distribution studies of non-characteristic x-radiation.** Thoe, R.S.; Sellin, I.A.; Liao, K.A.; Peterson, R.S.; Pegg, D.J.; Forester, J.; Griffin, P.M. (Tennessee Univ., Knoxville (USA); Oak Ridge National Lab., Tenn. (USA)). 1975. 6p. Dep. NTIS $4.50.

From 4. international conference on beam-foil spectroscopy; Gatlinburg, Tennessee, USA (15 Sep 1975).

Measurements of polarization of the non-characteristic x-radiation emitted from collisions between energetic (10—90 MeV) Al ions in thin foils are presented. 2 figs (GHT)

7648 (COO—2130-180) **Annual progress report for atomic and nuclear research with accelerators and fusion related atomic physics. Reporting period, October 1, 1974—September 30, 1975.** (Kansas State Univ., Manhattan (USA). Dept. of Physics). Oct 1975. Contract E(11-1)-2130. 111p. Dep. NTIS $6.50.

Topics covered include: laboratory operation and development; atomic collision cross sections in gases; ionization cross sections in thin solid materials; experimental impact-parameter dependent probabilities for k-shell vacancy production by fast heavy-ion projectiles; x-ray spectroscopy with high energy ions; atomic lifetime measurements; polarization studies of ion-induced x rays; theoretical spectra in ion-induced reactions; theoretical atomic cross section calculations; search for heavy-ion resonances; lifetimes of low energy states in ^{21}Ne; nuclear scattering and reactions; and trace element analysis. (GHT)

7649 (COO—2562-1) **Electron transfer experiments and atomic magnetism values. Progress report, February 1, 1975—September 30, 1975.** Bayfield, J.E.; Hughes, V.W. (Yale Univ., New Haven, Conn. (USA)). Oct 1975. Contract E(11-1)-2562. 10p. Dep. NTIS $4.50.

Progress in the first seven months of this new research is described. A new apparatus was constructed, tested and moved to Oak Ridge National Laboratory for studies using the Penning ion source test facility. Preliminary electron transfer cross section results for N^{4+}, N^{5+}, He^{2+} and C^{5+} ions on gases were obtained. Energy loss measurements made to date support expectations that single electron transfer for multiply-charged ions colliding with gas atoms produces excited final state ions. (auth)

7650 (COO—3129-41) **Experimental chemical kinetics: a study of chemical reactions by means of molecular beam techniques. Progress report, October 1974—October 1975.** Greene, E.F. (Brown Univ., Providence, R.I. (USA)). Oct 1975. Contract AT(11-1)-3129. 8p. Dep. NTIS $4.50.

Beams of electrons are shown to be able to control the motions of neutral molecules. A beam of electrons coaxial with a neutral beam of KCl molecules can restrict the divergence of the KCl beam to increase its signal on a detector by up to a factor of 10^4. Further, an electron beam can pump molecules from the residual gas in a vacuum chamber by forcing them to move preferentially along the electron beam into another chamber where they are detected by a mass spectrometer. Inelastic scattering of CsI by Ar and Xe and of CsCl by Ar with velocity selection and analysis at thermal energies shows large cross sections for the transfer of energy in amounts up to several vibrational quanta for both excitation and deexcitation of the molecules. The reaction LiCl + H yields Li + HCl is studied as it occurs on a Re surface as are the yields of positive and negative ions formed from cesium halides incident on a Nb surface. (auth)

7651 (LA-UR—75-2227) **Quasiclassical trajectory calculations of vibrational relaxation rates in some atom-diatomic molecule systems.** Thompson, D.L. (Los Alamos Scientific Lab., N.Mex. (USA)). 1975. Contract W-7405-ENG-36. 19p. (CONF-751142—1). Dep. NTIS $4.50.

From Army symposium on high energy lasers; Redstone Arsenal, Alabama, USA (3 Nov 1975).

Quasiclassical trajectory studies of energy transfer for a number of atom-diatomic molecule systems employing semiempirical (valence-bond) potential-energy surfaces are presented. The systems studied include: $I + H_2$, $Cl + H_2$, $Cl + HCl$, $H + HCl$, $F + HF$, $F + DF$, $H + HF$, $D + HF$, $H + DF$, $D + DF$, $I + I_2$, $Cl + Cl_2$, $H + HBr$, and $Br + HBr$. 10 figures, 16 references. (GHT)

7652 (LBL—4000, pp 235-236) **Measurement of K x-ray yield in 100 MeV Pb + Pb collisions and an approximate scaling law for K vacancy production in heavy-ion collisions with Z gt 10.** Meyerhof, W.E. (Univ. of California, Berkeley); Anholt, R.; Saylor, T.K.; Bond, P.D. Jul 1975.
In Nuclear chemistry. Annual report, 1974.

7653 (LBL—4000, pp 237-239) **Observation of molecular orbital K x-rays in heavy ion collisions.** Meyerhof, W.E. (Lockheed Palo Alto Research Lab., CA); Saylor, T.K.; Lazarus, S.M.; Little, W.A.; Triplett, B.B.; Chase, L.F. Jr.; Anholt, R. Jul 1975.
In Nuclear chemistry. Annual report, 1974.

7654 (LBL—4000, pp 240-242) **Description of the one and two collision molecular orbital x-ray yield.** Anholt, R. Jul 1975.
In Nuclear chemistry. Annual report, 1974.

7655 (LBL—4000, pp 243-244) **Secondary electron bremsstrahlung yield in symmetric heavy ion collision.** Anholt, R.; Rasmussen, J.O. Jul 1975.
In Nuclear chemistry. Annual report, 1974.

7656 (LBL—4000, pp 245-246) **X-ray continua in 60 MeV Br and 202 MeV Kr bombardments of Au, Pb, and U.** Anholt, R.

(State Univ. of New York, Albany); Rasmussen, J.O.; Bakhru, H.; Cue, N.; Saylor, T.K.; Lazarus, S.M.; Little, A. Jul 1975.
In Nuclear chemistry. Annual report, 1974.

7657 (LBL—4291) **Anode sputtering characteristics of the Berkeley 2.5 MV source.** Gavin, B. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1975. Contract W-7405-Eng-48. 6p. (CONF-751077—1). Dep. NTIS $4.50.
From IEEE conference on plasma science; Gatlinburg, Tennessee, USA (27 Oct 1975).
An investigation was made of a number of parameters affecting the performance of the SuperHILAC 2.5 MV Adam injector source. The description will emphasize anode sputtered materials, and will discuss in some detail calcium and gold ion production. Parameters varied include electrode geometry, support gas type and electrode bias, to optimize beam intensity and electrode consumption. A factor of three improvement with high n^+ gold ions appears evident with a new displaced electrode geometry. The source is operated in cold mode, is pulsed and operates usually at less than 0.6 amperes average current. Under these conditions source life has been measured to be sixteen hours at 25 percent duty factor when generating calcium ions with neon support gas. (auth)

7658 (ORO—4881-3) **Electron excitation cross sections for multiply charged ions. Progress report, March 1, 1975—February 29, 1976.** Henry, R.J.W.; Callaway, J. (Louisiana State Univ., Baton Rouge (USA). Dept. of Physics and Astronomy). 1975. Contract AT(40-1)-4881. 7p. Dep. NTIS $4.50.
Collision strengths for electron impact excitation of N^{4+} and Ne^{7+} are calculated for energies up to three times threshold energy for transitions 2s-2p, 2l-3l′ where $l = 0,1$ and $l' = 0, 1, 2$. A partial wave expansion for the incident electron wave function is made. For an electron with low orbital angular momentum, a closely-coupled expansion method over the 2s, 2p, 3d, 3p and 3d states of the ion is necessary in order to obtain an accuracy of 10 percent. Coulomb-Born approximation methods cannot be relied on for most transitions at the energies considered. A program for regular and irregular Whittaker functions has been developed. This will aid in an investigation of resonance structure in the collision strengths. Differing calculational methods are being investigated in order to compare speed and accuracy. (auth)

7659 (UCRL—77311) **Collisional quenching of metastable x-ray emitting states in a fast beam of He-like fluorine.** Matthews, D.L.; Fortner, R.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Sep 1975. Contract W-7405-Eng-48. 10p. (CONF-750975—4). Dep. NTIS $4.50.
From 4. international conference on beam-foil spectroscopy; Gatlinburg, Tennessee, USA (15 Sep 1975).
High resolution x-ray spectral measurements are used to determine the relative intensity of He-like fluorine x-ray transitions, $2\ ^3P_1$ yields $1\ ^1S_0$ and $^1P_1$ yields $^1S_0$, produced in fluorine collisions with Ne, Ar, and Kr gas targets at various pressures and in thin carbon foils and a thick carbon slab. The relative intensities are observed to be strong functions of both target density and incident charge Z. These effects are attributed to strong collisional quenching of both initial states by subsequent large impact parameter collisions. The data permit extraction for the first time of the total quenching cross sections (sigma/sub Q/) for fast fluorine ions in both states. A strong enhancement of the relative intensity of the $2\ ^3P_1$ is observed for F^{7+} projectiles. This strong enhancement is attributed to selective excitation of metastable states in the beam, i.e., $1s2s\ ^3S_1$, into the $1s2p\ ^3P_1$ state. Finally, the data for foil and solid targets are used to obtain new information on the excitation states of ions moving in solids. High resolution measurements of the radiative electron capture (REC) peak are reported and analyzed for the first time. 3 figs, 1 table (auth)

7660 **Rate constants for the CO_2 02^00—10^00 relaxation.** Jacobs, R.R.; Pettipiece, K.J.; Thomas, S.J. (Univ. of California, Livermore). *Phys. Rev., A;* **11**: No. 1, 54-59(Jan 1975).
An absorption-cell technique is utilized to determine the rate constants for the CO_2 02^00-10^00 relaxation in CO_2 and binary-gas mixtures of CO_2-He and CO_2-N_2. The experiment consists of injecting an approximately 2-nsec 10.4-μm pulse through the absorption cell—saturating the CO_2 10^00 to 00^01 transition, and monitoring the subsequent molecular re-equilibrations by recording the temporal intensity of a spatially overlapping probe beam in the 9.4-μm band connecting the 02^00 and 00^01 states. The measured rate constants are k/sub CO_2-CO_2/ = 3 +- 1, k/sub CO_2-He/ = 0.8 +- 0.3, and k/sub CO_2-N_2/ = 3 +- 1, all in units of 10^5 sec^{-1} $Torr^{-1}$. The experimental approach also yields information on the thermalization of other processes having slower rates, and these are discussed qualitatively. Finally, a comparison is made with other related experimental investigations and two calculations which predict values for k/sub CO_2-CO_2/ appreciably different from those measured. (5 figs., 16 refs.) (auth)

7661 **Photoionization and ion cyclotron resonance studies of the reaction $C_2H_4^+ + C_2H_4$ yields $C_3H_5^+ + CH_3$.** LeBreton, P.R. (California Inst. of Tech., Pasadena); Williamson, A.D.; Beauchamp, J.L.; Huntress, W.T. *J. Chem. Phys.;* **62**: No. 5, 1623-1631(1 Mar 1975).
High pressure photoionization mass spectrometry has been employed to study the ion molecule reaction $C_2H_4^+ + C_2H_4$ yields $C_3H_5^+ + CH_3$ at wavelengths between 700 and 1180 A. Measurements have been made of the apparent ionization cross section of both $C_2H_4^+$ and $C_3H_5^+$ as a function of photon energy. The threshold energy for the reaction is 10.51 eV. The reaction cross section decreases as the internal energy of the ionic reactant increases. Vibrational structure, observed in the $C_2H_4^+$ photoionization efficiency curve immediately above threshold (10.51—11.7 eV) permits a rough estimate of the change in reaction cross section with vibrational excitation. In the energy region between 11.7 and 12.1 eV a slight increase in the $C_2H_4^+$ photoionization efficiency curve appears which is not reflected in the $C_3H_5^+$ curve. A large increase in the photoionization efficiency curve of C_2H_4+ occurs at 12.2 eV, the threshold of the $^2B_2$ first excited electronic state of the ion. A dramatic decrease is observed in the reaction probability of $C_2H_4^+$ formed at energies above 12.2 eV. The cross section for reaction in the excited $^2B_2$ state is equal to or less than 13% of the cross section for reaction in the lowest vibrational level of the ground electronic state. The observed decrease in reactivity is independent of repeller voltage at ion exit energies below 3 eV. Pressure studies reveal that after one or two collisions, the reactivity of $C_2H_4^+$ is re-established, suggesting that relaxation of internal excitation is an efficient process. The change in reactivity of $C_2H_4^+$ with internal energy is compared to the effects of tranlation excitation as determined using the techniques of ion cyclotron resonance spectroscopy. (auth)

7662 **Multichannel photodetachment theory.** Lee, C.M. (Univ. of Chicago). *Phys. Rev., A;* **11**: No. 5, 1692-1699(May 1975).
A general theoretical treatment of multichannel photodetachment is presented, with application to Cs^- photodetachment from 14,800 to 15,600 cm^{-1}. The sharp and strong resonances near the first ^3P states of the Cs atom, observed by Patterson et al., were reproduced by fitting eight physically meaningful parameters of a general theoretical framework. Predictions are also made concerning the branching ratios, the angular distribution, and the spin orientation of the detached electrons as well as the orientation of the excited neutral Cs atoms. (auth)

7663 **Auger spectrum of the noble gases. II. Argon.** McGuire, E.J. (Sandia Labs., Albuquerque, NM). *Phys. Rev., A;* **11**: No. 6, 1880-1888(Jun 1975).
Theory and experiment are compared for the $L_{23}MM$ principal and satellite spectra of argon. For the principal spectrum it is shown that theory and experiment are in excellent agreement if the doublet conventionally assigned to L_{23}-M_1M_1 is reassigned to L_{23}-$M_1M_{23}(P)$. It is hypothesized that the splitting of the P term is due to configuration interaction with the $(3p)^3{}^2D(3d)^1P$ term of Ar^{2+}. The reassignments enable us to locate, tentatively several unknown singlet levels in Ar^{2+}. An examination of the satellite spectrum confirms Mehlhorn's assignment of the terms in the Ar^{2+} $(2p)^5(3s)^2$ $^{(4,2)}P^5$ configuration. The calculated satellite spectra agree with experiment in spectral shape (the location of peaks) and agree to a factor of 2 in individual satellite peak intensity. The satellite calculations support Mehlhorn's conclusion that theory considerably overestimates the L_1-$L_{23}M_1$ Auger transition rate. (auth)

7664 **Quasiclassical trajectory study of the $H_2 + F_2$ reactions.** Thompson, D.L. (Los Alamos Scientific Lab., NM); McLaughlin, D.R. *J. Chem. Phys.;* **62**: No. 11, 4284-4299(1 Jun 1975).
A theoretical investigation of the reaction dynamics of the reactions H_2(v = 0,2,4 or 6) + F_2(v = 0 or 6) yields H + HF + F, 2HF, F_2H + H, H_2F + F, F_2 + 2H, and H_2 + 2F has been accomplished using Monte Carlo averaging over quasiclassical trajectories on a reasonable semiempirical potential-energy surface. The details of the dynamical mechanism of the reaction processes were investigated by examining geometrically restricted reaction paths and selected restricted initial states. Reaction cross sections have been computed and estimates of rate coefficients have been made. The computed thermal rates are many orders of magnitude lower than thermal collision frequencies. Reaction thresholds are lowered significantly for vibrationally excited hydrogen. 10 figures, 9 tables, 59 references. (auth)

7665 **Studies of inelastic molecular collisions using impact parameter methods. III. Line shape functions.** Fisanick-Englot, G.; Rabitz, H. (Princeton Univ., NJ). *J. Chem. Phys.;* **63**: No. 4, 1547-1554(15 Aug 1975).

Extension of impact parameter methods within an effective Hamiltonian framework is made to yield generalized cross sections or transition rates such as those encountered in spectral line broadening. An exact impact parameter expression is derived for the diagonal elements of the generalized cross sections. Approximations to the exact impact parameter expression are discussed, and it is shown that they involve two stages: (1) approximation of the S-matrix elements and (2) replacement of a sharply peaked nonlocal impact parameter kernel by a delta function. The special case of a high-energy exponential impact parameter form is used for illustration. (auth)

7666 Energy transfer from argon resonance states to nitrogen, hydrogen, and nitric oxide. McNeely, J.R.; Hurst, G.S.; Wagner, E.B.; Payne, M.G. (Oak Ridge National Lab., TN). *J. Chem. Phys.*; **63**: No. 6, 2717-2723(15 Sep 1975).

Transfer of electronic energy from the resonance states $Ar(^1P_1)$ and $Ar(^3P_1)$ to diatomic nitrogen, hydrogen, and nitric oxide has been studied with a time-resolved quenching technique. Rate constants for energy transfer were deduced from the changes of the rate of decay of excited states corresponding to known changes of the density of the diatomic molecules. For $Ar^*—N_2$ the rate constants were 5.4 x 10^{-11} and 0.8 x 10^{-11} molecule^{-1} cm^3 sec^{-1} for $Ar(^1P_1)$ and $Ar(^3P_1)$, respectively. For $Ar^*—H_2$, the measured rate constants were 22 x 10^{-11} and 21 x 10^{-11} molecule^{-1} cm^{3}sec^{-1} for $Ar(^1P_1)$ and $Ar(^3P_1)$, respectively. The results for nitric oxide were 54 x 10^{-11} and 32 x 10^{-11} molecule^{-1} cm^{3}sec^{-1} for $Ar(^1P_1)$ and $Ar(^3P_1)$, respectively. (auth)

7667 Core-excited autoionizing states in the alkali metals. Pegg, D.J.; Haselton, H.H.; Thoe, R.S.; Griffin, P.M.; Brown, M.D.; Sellin, I.A. (Univ. of Tennessee, Knoxville). *Phys. Rev., A;* **12**: No. 4, 1330-1339(Oct 1975).

An extension of projectile-electron spectroscopy to keV-energy alkali-metal beams has permitted the first observations of the energies of a number of optically forbidden core-excited autoionizing states of the alkali metals. For example, the $(1s2s^2)^3S$ and the $(1s2p^2)^3D$ states of Li which lie at 56.31 +- 0.03 eV and 61.04 +- 0.03 eV, respectively, above the ground state have been located. Energies for theoretically less-well-established doublet and quartet states in Na, Mg^+, and K are also presented. 10 figures, 3 tables, 20 references. (auth)

7668 Double photoionization of neon. Chang, T.N. (Univ. of Chicago); Poe, R.T. *Phys. Rev., A;* **12**: No. 4, 1432-1439(Oct 1975).

A calculation of the double photoionization of neon using many-body perturbation theory has permitted a quantitative study of the relative importance of various contributing effects, i.e., ground-state correlations, inelastic internal collisions, core rearrangement, and a virtual Auger transition. The results are in good agreement with experimental data. The energy distribution between two outgoing electrons and the ratio of double to single photoionization are calculated and discussed. (auth)

7669 Anisotropic interband effects in electroreflectance of Ag. Furtak, T.E.; Lynch, D.W. (Ames Lab., Iowa). *Phys. Rev. Lett.*; **35**: No. 14, 960-963(6 Oct 1975).

Measurements of the normal-incidence electroreflectance of clean, strain-free single crystals of Ag and Au with use of a novel drop-electrolyte technique shown an anisotropy on the (110) face of Ag which is not present on Au. It can be explained by field-induced indirect interband transitions which are observed in Ag but not in Au. This work shows that part of the electroreflectance spectrum of Ag arises from electrons which interact with the periodic crystal potential. (auth)

7670 Relativistic and correlation effects in the 21.2-eV photoemission spectrum of atomic lead. Suezer, S.; Banna, M.S.; Shirley, D.A. (Univ. of California, Berkeley). *J. Chem. Phys.*; **63**: No. 8, 3473-3477(15 Oct 1975).

Photoelectron spectra were obtained for atomic lead in the 700—800°C range, using HeI radiation (21.1 eV) and a special, high-temperature cell. Relativistic effects were obvious, most notably in the relative intensity of 1.000:0.071 in the peaks arising from $Pb^+(s^2p;\ ^3P/\text{sub } {}^1/_2/):Pb^+(s^2p;\ ^3P/\text{sub } {}^3/_2/)$ states. This is a consequence of the $Pb(s^2p^2;\ ^3P_0)$ ground state being in fact mostly $s^2p^2/\text{sub } {}^1/_2/$. Correlation effects were also apparent. Several final states inaccessible from an s^2p^2 initial-state configuration were reached; this was explained by admixtures of the configurations sp^2d and s^2d^2 into the initial state. All transitions that would be allowed by the presence of these peaks were actually found. These "direct" observations of configuration interaction give an operational meaning to this concept that is not available to most spectroscopic methods. Energy-loss peak were observed at higher pressure and attributed to excitation of optical levels in neutral Pb by photoelectrons. (auth)

7671 Small-angle scattering of hydrogen atoms and protons in various gases. Thomas, E.W.; Leatherwood, L.A.; Harriss, J.E. (School of Physics, Georgia Institute of Technology, Atlanta, Georgia 30332). *Phys. Rev., A;* **12**: No. 5, 1835-1839(Nov 1975).

Cross sections have been measured for the differential (in angle) scattering of 15-keV H^+ and H^0 in targets of He, Ar, H_2, and N_2. Separate cross sections are presented for scattering projectiles in the singly charged (H^+), neutral (H^0), and negatively charge (H^-) states; scattering angles range from 0.5 to 10 deg. Summing these constituent cross sections we arrive at a "total" cross section for scattering all projectiles into a particular angle. This "total" differential cross section is compared with predictions using a simple screened Coulomb potential; for the molecular targets the cross section is taken to be twice that for the corresponding atom. For H^+ and H^0 impact on He and H_2 the measured cross section agrees with the predicted value; in these cases the effect of screening is negligible. For H^+ and H^0 impact on Ar and N_2 the measurements agree fairly well with the screened Coulomb calculation at angles up to 1.5 deg and then fall lower than the predictions at larger angles; theory and experiment differ by a factor of 2 at 10 deg in one case. For all cases considered the formation of scattered H^- ions occurs in less than 2% of the collision events. (AIP)

7672 High-resolution line broadening and collisional studies in CO_2 using nonlinear spectroscopic techniques. Meyer, T.W.; Rhodes, C.K.; Haus, H.A. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). *Phys. Rev., A;* **12**: No. 5, 1993-2008(Nov 1975).

High-resolution line-broadening studies have been made of CO_2 in collision with a wide variety of foreign gas perturbers. These measurements have been made by observation of the narrow saturated resonance in the 4.3-μm fluorescence emitted from a low-pressure CO_2 gas which is subjected to a saturating standing-wave electric field from a CO_2 oscillator operating on a 9.6- or 10.6-μm transition. The collision partners which have been investigated are CO_2, N_2O, N_2, NO, CO, O_2, H_2, D_2, ^3He, ^4He, Ne, Ar, Kr, Xe, NH_3, and CH_4. A semiclassical theory of the 4.3-μm saturated resonance is developed which accounts for the effects of phase-interrupting collisions, beam transit time, and optical intensity. The observation of a previously unobserved downward curvature of the CO_2 linewidth data at low pressure is attributed to the influence of the transit time effect. The experimentally determined pressure-broadening coefficients include the important correction for the contribution of power broadening. These power-corrected results for CO_2, N_2, and ^4He have been used to predict successfully the observed gain characteristics of high-pressure (>1 atm) CO_2 amplifiers, as observed in other studies. We have also appraised our observed broadening coefficients in the context of the pressure-broadening theory developed by Murphy and Boggs in order to characterize quantitatively the intermolecular interactions. The comparison of theory and experiment indicates the need for an explicit incorporation of vibration perturbations in the theoretical analysis, particularly when vibrational resonance is present. (AIP)

7673 Core photoelectron spectroscopy of some volatile phosphorus halides. Cavell, R.G. (Univ. of California, Berkeley). *Inorg. Chem.*; **14**: No. 11, 2828-2831(Nov 1975).

Core level (P/sub 2p/) apparent binding energies of gaseous PF_5 (144.65 eV), OPF_3 (143.30 eV), SPF_3 (142.72 eV), PF_3 (141.95 eV), $OPCl_3$ (141.3 eV), $SPCl_3$ (140.8 eV), and PCl_3 (140.1 eV) (vs. Ar/sub $2p_{3/2}$/ at 248.62 eV) excited by Mg Kα radiation were measured. Also measured were F/sub 1s/, O/sub 1s/, Cl/sub 2s/, Cl/sub 2p/, S/sub 2p/, S/sub 2s/, and some P/sub 2s/ apparent binding energies on these same compounds. The P/sub 2p/ binding energies display regular trends with respect to formal charge, electronegativity, and the relaxation potential model (RPM) utilizing modifed CNDO potentials. The CNDO ground potential model (GPM) fails to predict the correct direction of binding energy shifts for $OPCl_3$ and $SPCl_3$. The F/sub 1s/ peak of PF_5 shows evidence for two fluorine atom environments in this molecule. (auth)

7674 Collisional ionization of Na, K, and Cs by CO_2, COS, and CS_2: molecular electron affinities. Compton, R.N.; Reinhardt, P.W.; Cooper, C.D. (Health Physics Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *J. Chem. Phys.*; **63**: No. 9, 3821-3827(1 Nov 1975).

The negative ion products resulting from collisions between orthogonal beams of alkali metal atoms (Na, K, Cs) and the linear triatomic molecules CO_2, COS, and CS_2 have been studied from threshold to ~ 400 eV (lab). Ions with masses corresponding to the parent molecules CO_2, COS, and CS_2 are detected for all collision permutations except for Na colliding with CO_2. The following electron affinities are deduced from measurements of the threshold for the ion pair production reactions: CO_2(-0.60 +- 0.2 eV), COS(+0.46 +- 0.2 eV), and CS_2(1.0 +- 0.2 eV). The CO_2^- ion was

found to be metastable with respect to autodetachment. This result is compatible with the negative electron affinity for CO_2 and in agreement with our earlier observations of CO_2^{-*} and with recent theoretical calculations. The lifetime of CO_2^{-*} ($9 +- 2 \times 10^{-5}$ sec) was measured to be independent of collision energy over the region of energy studied (threshold to ~ 20 eV c.m.). The fragment ions O^-/CO_2, O^-/COS, S^-/COS, and S^-/CS_2 were detected at a threshold energy which is consistent with the known energetics of the reactions. These results are compared with recent dissociative electron attachment studies. (AIP)

7675 Dissociative ionization of molecules by electron impact. I. Apparatus and kinetic energy distributions of D^+ ions from D_2. Stockdale, J.A.D.; Anderson, V.E.; Carter, A.E.; Deleanu, L. (Health Physics Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *J. Chem. Phys.;* **63**: No. 9, 3886-3897(1 Nov 1975).

A crossed beam apparatus for the study of electron impact dissociative ionization of molecules is described. D^+ time-of-flight and energy spectra are presented for impact of electrons on D_2, from energies near dissociative threshold to 300 eV. In addition to the group of D^+ ions peaking near 8 eV kinetic energy from dissociative ionization via the $^2\Sigma^+$/sub u/ state of D_2^+, groups of ions of lower kinetic energy peaking near 5, 2, and possibly near 1 eV are observed. These ions appear to be due to excitation of states of D_2 or D_2^+ lying near to or above the $^2\Sigma^+$/sub u/ state of D_2^+. (AIP)

7676 Dissociative ionization of molecules by electron impact. II. Kinetic energy and angular distributions of N^+ and N^{++} ions from N_2. Deleanu, L.; Stockdale, J.A.D. (Health Physics Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *J. Chem. Phys.;* **63**: No. 9, 3898-3906(1 Nov 1975).

An apparatus containing crossed molecular and pulsed electron beams has been used to obtain distributions in kinetic energy and angle of fast (>1.5 eV) N^+ and N^{++} ions produced through dissociative ionization of N_2 by impact of electrons with energies from threshold to 300 eV. Previously unreported structure is found in both N^+ and N^{++} kinetic energy spectra. The angular distributions of N^+ (energy resolved) and N^{++} (total) ions are found to be substantially isotropic for electron beam—ion detector angles from 30^0 to 110^0. (AIP)

7677 Dissociation of H_3^+ to form metastable hydrogen. Thomas, E.W.; Fitzwilson, R.L.; Sauers, I.; Ford, J.C. (School of Physics, Georgia Institute of Technology, Atlanta, Georgia 30332). *J. Chem. Phys.;* **63**: No. 9, 4092-4093(1 Nov 1975).

The differential cross section for the formation of metastable hydrogen atoms from H_3^+ is measured for the system of H_3^+ beam scattering on a gas target of H_2, Ar, and N_2. (AIP)

7678 Vibrational relaxation of NO in collisions with atomic oxygen and chlorine. Glaenzer, K.; Troe, J. (Inst. of Physical Chemistry, Lausanne, Switzerland). *J. Chem. Phys.;* **63**: No. 10, 4352-4357(15 Nov 1975).

The vibrational relaxation of $NO(X^2\Pi)$ in the $v = 0$, 1, and 2 states in collisions with Ar, NO, NO_2, and electronic ground state O and Cl atoms has been studied in shock waves. O and Cl atoms were produced in the thermal dissociation of NO_2 or N_2O at T approximately equal to 2700 K, and of ClNO at T approximately equal to 1700 K, respectively. Both atoms were found to be very efficient catalysts for vibrational energy transfer to NO. The relaxation rates observed suggest a mechanism involving bound $(NO_3)^*$ and $(ClNO)^*$ collision complexes. (auth)

7679 Collision-induced emission from $O(^1S)$ by He, Ar, N_2, H_2, Kr, and Xe. Black, G.; Sharpless, R.L.; Slanger, T.G. (Stanford Research Inst., Menlo Park, CA). *J. Chem. Phys.;* **63**: No. 10, 4546-4550(15 Nov 1975).

Collision-induced emission from $O(^1S)$ has been studied for collisions with He, Ar, N_2, H_2, Kr, and Xe. The $O(^1S)$ was made by CO_2 photodissociation at 1120 A and N_2O photodissociation at 1290 A. For all but Xe the emitted intensity (including both atomic line and associated molecular bands) increased linearly with the added gas pressure. This was not true at low pressures of Xe—the observed behavior in this case was used to deduce the rates for formation and collisional dissociation of XeO. (auth)

7680 Collision-induced emission from $S(^1S)$ by He, Ar, N_2, H_2, Kr, and Xe. Black, G.; Sharpless, R.L.; Slanger, T.G. (Stanford Research Inst., Menlo Park, CA). *J. Chem. Phys.;* **63**: No. 10, 4551-4555(15 Nov 1975).

Collision-induced emission from $S(^1S)$ has been studied for collisions with He, Ar, N_2, H_2, Kr, and Xe. The $S(^1S)$ was made by OCS photodissociation at 1610 A. The emitted intensity increased linearly with the added gas pressure. This behavior can be described by rate coefficients for induced emission on the ^1S yields ^1D transition of $(5.6 +- 0.9) \times 10^{-20}$ cm^3 molecule^{-1}.sec^{-1} for helium, $(4.2 +- 0.3) \times 10^{-18}$ for argon, $(3.3 +- 0.2) \times 10^{-18}$ for nitrogen, $(1.73 +- 0.15) \times 10^{-18}$ for hydrogen, $(1.5 + - 0.1) \times 10^{-17}$ for krypton, and $(1.1 +- 0.05) \times 10^{-16}$ for xenon. Xenon was also found to enhance the ^1S yields ^3P emission intensity with a rate coefficient of $(5.5 +- 1.0) \times 10^{-19}$ cm^3 molecule^{-1}.sec^{-1}. Induced emission is a major (and possibly exclusive) path for deactivation of $S(^1S)$ by all these gases except hydrogen. (auth)

7681 Energy absorption by N_2O in the 4 to 14 eV region. Huebner, R.H.; Celotta, R.J.; Mielczarek, S.R.; Kuyatt, C.E. (Argonne National Laboratory, Argonne, Illinois 60439). *J. Chem. Phys.;* **63**: No. 10, 4490-4494(15 Nov 1975).

Apparent oscillator-strength values for transitions in the 4 to 14 eV region in nitrous oxide have been derived from electron energy-loss measurements. Detailed comparison with photoabsorption measurements in the ultraviolet region indicates a weak transition below the $^1\Delta$reverse arrowX $^1\Sigma^+$ transition at 6.8 eV not observed optically. This analysis also provides oscillator-strength values in the region between 11.5 and 12.4 eV, where no quantitative photoabsorption data are available. (AIP)

ATOMIC AND MOLECULAR THEORY

7682 (CONF-750844—2) **Multiple excitation in free molecules.** Carlson, T.A. (Oak Ridge National Lab., Tenn. (USA)). 1975. 11p. Dep. NTIS $4.00.

From Summer course in atomic physics; Carry-le-Rouet, France (31 Aug 1975).

Multiple excitation in molecules offers a number of new challenging problems that are not found in atomic systems. In particular, there is the interesting question of the nature of electron shakeup as the result of producing a localized and non-central potential. In fact, is it correct to assume that only monopole transitions occur. There is a strong need for extending fundamental studies in the general field of molecules, particularly in the area of theory. In addition, the investigation of strong shakeup satellites in complex molecules can be used to shed light on the nature of chemical bonding for these species. 21 refs, 3 tables, 3 figs. (auth)

7683 (COO—1674-113) **Basic studies of atomic dynamics. Progress report, October 1, 1974—September 30, 1975.** Fano, U. (Chicago Univ., Ill. (USA)). 1 Oct 1975. Contract E(11-1)-1674. 9p. Dep. NTIS $4.50.

Topics covered include: fitting many-body theories into the theory of atomic spectra and collisions; variation of atomic properties along the periodic system; angular distribution of collision products (electron-atom collisions); application of atomic points of view to crystal lattice phenomena; and double photoionization of neon. (GHT)

7684 (ANL-Trans—980) **Expansion in 1/Z of the Hartree—Fock and correlation energies, relativistic corrections, and dipole matrix element.** Safronova, U.I. Translated from *J. Quant. Spectrosc. Radiat. Transfer;* **15**: No. 3, 231-242(1975). 14p. Dep. NTIS $4.00.

Energies and dipole matrix elements have been calculated for He, Li, Be, B, C, N, O, F, and Ne-like ions in configurations $1s^22s$/sup n1/2p/sup n2/ (2 greater than or equal to n_1 greater than or equal to 0.6 greater than or equal to n_2 greater than or equal to 0). The Hartree-Fock energy, the correlation energy, and relativistic corrections were taken into account. Numerical results are presented for various energies and fine structures. Dipole matrix elements are required for calculation of oscillator strengths or transition probabilities. For the dipole matrix elements, two terms of the expansion of 1/Z have been obtained. Numerical results are presented. (GHT)

7685 Semiclassical limit of quantum mechanical transition state theory for nonseparable systems. Miller, W.H. (Univ. of California, Berkeley). *J. Chem. Phys.;* **62**: No. 5, 1899-1906(1 Mar 1975).

The semiclassical limit of quantum mechanical transition state theory is derived by invoking the classical path approximatiin for the Boltzmann density operator and making use of the stationary phase approximation; separability of motion along a reaction coordinate is not assumed. The resulting expression for the rate constant bears an interesting similarity to that of conventional transition state theory, although all quantities in it refer to the full classical dynamics on the potential energy surface. In place of the vibrational frequencies of the "activated complex" which appear in the conventional theory, for example, the semiclassical expression contains characteristic frequencies related to the stability properties of a periodic classical trajectory. Conservation of total angular momentum is easily accounted for in a rigorous manner so that the semiclassical model can be applied to three-dimensional dynamical systems. (auth)

7686 Difference in dipole moment for molecules in different zero-field levels of the lowest triplet state by Stark—PMDR spectroscopy. Sheng, S.J.; El-Sayed, M.A.; Leung, M. (Univ. of California, Los Angeles). *J. Chem. Phys.;* **62**: No. 5, 1988-1990(1 Mar 1975).

The effects of spin-orbit coupling between singlet and triplet states, and between the triplet states themselves at the moment of transition between the zero-field levels of the lowest triplet state, have been investigated previously. The same coupling could induce variation in the permanent dipole moment of molecules in the different zero-field levels of the same electronic triplet state. Such difference can be detected by the first order Stark effect on the zero-field phosphorescence microwave double resonance signals. The observation of this effect is reported. Molecules in the different zero-field levels of the lowest triplet state of duraldehyde can differ in their dipole moment by approximately 10^{-3} D. (GHT)

7687 Zero field optically detected magnetic resonance of multiple localized states in 1,4-dibromonaphthalene crystals. Nishimura, A.M.; Zewail, A.H.; Harris, C.B. (Univ. of California, Berkeley). *J. Chem. Phys.;* **63**: No. 5, 1919-1925(1 Sep 1975).

A systematic study of the localized states of 1,4-dibromonaphthalene was made, both as a dilute guest in a host crystal and as a trap site in the neat crystal, utilizing zero field magnetic resonance techniques. The kinetic parameters associated with the various "localized" triplet states have been determined. These include the relative intersystem crossing rates, the relative radiative rates from the spin states to the electronic and vibronic origins, and the total depletion rates from the individual spin sublevels. The results of these studies indicate that the correlation of the magnetic structure of trap states and the energy difference between traps and a host band is not straightforward, even for one-dimensional systems. Moreover, these results imply that spin exchange and equilibrium between traps and band states can severely influence the dynamics of energy migration and must be incorporated into any temperature dependent line shape analysis of the exciton transitions, particularly for 1,4-dibromonaphthalene because of the similarity in trap and exciton EPR frequencies. (auth)

7688 Addendum to 'Effects of retardation on electromagnetic self-energy of atomic states'. Au, C.K. (Yale Univ., New Haven); Feinberg, G. *Phys. Rev., A;* **12**: No. 4, 1722(Oct 1975).

Electromagnetic self-energy shifts for the 2S states of hydrogenic ions for Z = 10, 20, 30, 40, 50, 60, and 70 are presented. The results are computed nonrelativistically and with retardation according to a recent prescription of ours. (auth)

7689 Relationship between the rotational and spin-rotational correlation times. O'Reilly, D.E. (Argonne National Lab., IL). *J. Chem. Phys.;* **63**: No. 7, 3177-3178(1 Oct 1975).

An alternate model for molecular reorientation in the liquid state is presented as a comment on the extended J-diffusion model used by Bull in an earlier paper. The alternate, the quasilattice random flight model, assumes that the rotational potential energy barriers are large enough so that molecular rotation only occurs in the event of a hard binary molecular collision. The alternate model is applied to Bull's data on spin relaxation time for deuterated trifluorobenzene. 1 fig. (GHT)

7690 B-spline expansion bases for excited states and discretized scattering states. Shore, B.W. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). *J. Chem. Phys.;* **63**: No. 9, 3835-3840(1 Nov 1975).

High-order B-splines provide effective basis functions for constructing solutions to the Schroedinger equation. For high-lying levels of the Morse potential, septic splines yield an accuracy comparable to harmonic oscillators. They can also approximate hydrogenic wavefunctions; typically one-third of the N eigenvalues of an N x N matrix are more accurate than 0.01%. Matrix eigenvectors can also represent scattering states. The approximation is uniformly valid spatially when basis functions terminate sharply. (AIP)

7691 Extended Hueckel calculation of repulsive interactions in nobel gases. Hathaway, K.B.; Krumhansl, J.A. (Cornell Univ., Ithaca, NY). *J. Chem. Phys.;* **63**: No. 10, 4308-4312(15 Nov 1975).

Repulsive potential energies for al of the possible pairs of atoms of the noble gases helium, neon, and argon are calculated by the semiempirical extended Hueckel molecular orbital method. The agreement of the calculated energies with other theoretical results is significantly improved by computing overlaps using analytic approximations to the atomic Hartree-Fock atomic orbitals instead of the more commonly used Slater functions. (auth)

FLUID PHYSICS

GENERAL FLUID DYNAMICS

7692 (ENSAM—74-5, pp 35-55) **Flow visualization using bubbles.** Henry, J.P. 1974. (In French).

In Ecole Nationale Superieure d'Arts et Metiers. Scientific and technical publications. 1974-5.

Soap bubbles were used for visualizing flows. The tests effected allowed some characteristics of flows around models in blow tunnels to be precise at mean velocities $V_o < 30$/s and for a Reynolds number $Re < 5 \cdot 10^5$. The velocity of a bubble is measured by chronophotography, the bulk envelope of the trajectories is also registered. (FR)

7693 GAP—a PIC-type fluid code. Marder, B.M. (Los Alamos Scientific Lab., NM). *Math. Comput.;* **29**: No. 130, 434-446(Apr 1975).

GAP, a PIC-type fluid code for computing compressible flows, is described and demonstrated. While retaining some features of PIC, it is felt that the GAP approach is conceptually and operationally simpler. 9 figures. (auth)

OTHER QUANTUM FLUIDS

7694 MONOLAYER AND SUBMONOLAYER HELIUM FILMS. SYMPOSIUM ON MONOLAYER AND SUBMONOLAYER HELIUM FILMS, HOBOKEN, NEW JERSEY, JUNE 7—8, 1973. Daunt, J.G.; Lerner, E. (eds.). New York; United States of America (USA); Plenum Press (1973). 165p. (CONF-730635—). $15.00.

From Symposium on monolayer and submonolayer helium films; Hoboken, New Jersey, USA (7 Jun 1973).

This volume contains the proceedings of a symposium held at Stevens Institute of Technology on June 7 and 8, 1973. The symposium was devoted largely to papers on the subject of thin (unsaturated) helium films at low temperature; many were of a review character. In addition, some papers of a more general character were included to review some powerful techniques used for investigating surfaces at higher temperatures. Two of the papers have already been abstracted in NSA with the abstract numbers 28: 20604 and 29: 22733. (RWR)

PARTICLE INTERACTIONS AND PROPERTIES - EXPERIMENTAL

7695 (UCLA—10-P25-33) **Annual progress report to U.S. Energy Research and Development Administration.** Haddock, R.P.; Nefkens, B.M.K. (California Univ., Los Angeles (USA). Dept. of Physics). Oct 1975. Contract AT(11-1)-GEN-10. 25p. Dep. NTIS $3.50.

Experimental research on strong interactions is summarized. (JFP)

ELECTROMAGNETIC INTERACTIONS

7696 Measurement of the electron—deuteron elastic scattering cross section in the range 0.8 less than or equal to q^2 less than or equal to 6 GeV^2. Arnold, R.G. (American Univ., Washington, DC); Chertok, B.T.; Dally, E.B.; Grigorian, A.; Jordan, C.L.; Schuetz, W.P.; Zdarko, R.; Martin, F.; Mecking, B.A. *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 26, 373-387(1975).

From 6. international conference on high energy physics and nuclear structure; Santa Fe, New Mexico, USA (9 Jun 1975).

See CONF-750631—.

Preliminary results of elastic ed scattering at large momentum transfer performed at the Stanford Linear Accelerator Center using two high resolution spectrometers in coincidence are reported. The deuteron structure function $A(q^2)$ at 9 values of q^2 is deduced from a comparison of elastic ed and ep coincident yields and the world's ep cross sections. These measurements extend the range of q^2 by 4.5 over previous work, and in this new range $A(q^2)$ is observed to approach $1/q^{20}$ momentum dependence. The results are in sharp disagreement with the meson exchange calculations, and they are in rough agreement with the nonrelativistic potential models, and they are in agreement with the predictions of the quark dimensional scaling model which pictures the deuteron as a bound state of 6 quarks at large momentum transfer. (auth)

WEAK INTERACTIONS

7697 (BNL—20544) **Recent results from the Brookhaven National Laboratory 7' bubble chamber.** Cazzoli, E.G.; Cnops, A.M.; Connolly, P.L.; Murtagh, M.J.; Palmer, R.B.; Samios, N.P.; Tso, T.T.; Williams, H.H. (Brookhaven National Lab., Upton, N.Y. (USA)). 1975. 19p. (CONF-750855—13). Dep. NTIS $4.50.

From International symposium on lepton and photon interactions at high energies; Stanford, California, USA (21 Aug 1975).

In this presentation the equipment is briefly described and the method of analysis used for all events is reviewed. New results are then presented on the ratio of neutrino cross sections on neutrons to that on protons. One is reminded of the published event indicating an apparent $\Delta S = -\Delta Q$ current. Finally, the parameters of all the other charged current events containing at least one strange particle are presented. (auth)

7698 **Negative muon spin rotation experiment.** Yamazaki, T.; Nagamine, K.; Nagamiya, S.; Hashimoto, O. (Univ., Tokyo). *AIP (Am. Inst. Phys.) Conf. Proc.*; No. 26, 587-597(1975).

From 6. international conference on high energy physics and nuclear structure; Santa Fe, New Mexico, USA (9 Jun 1975).

See CONF-750631—.

Results of the experimental project using negative muon spin rotation at Lawrence Berkeley Laboratory are reported. The following were discussed briefly: the bound muon g factors from the viewpoints of the relativistic and nuclear polarization effects, strange depolarization phenomena in terms of the difference between the muonic-atom probe and its equivalent nuclear probe, application of μ^-0 probe to studies of magnetic oxides, and total muon capture rates in the actinide region. (auth)

7699 **Caltech—Fermilab neutral current search.** Barish, B.C. (California Inst. of Tech., Pasadena). pp 561-565 of In Lepton and hardon structure. Vol. 12. Zichichi, A. (ed.). London; Academic Press Inc. (1975).

From International school of subnuclear physics; Erice, Italy (14 Jul 1974).

CONF-740731—.

The question of the existence or nonexistence of neutral currents at or near the reported levels in the inclusive reactions ν(anti ν) + N yields ν(anti ν) + hadrons was studied. Evidence was found for neutrino-like interactions with no muon in the final state. These results are consistent with previous results and seem to point to the existence of neutral currents as an explanation. (JFP)

7700 **Study of single pion production by neutral currents.** Derrick, M. (Argonne National Lab., IL). pp 567-574 of In Lepton and hardon structure. Vol. 12. Zichichi, A. (ed.). London; Academic Press Inc. (1975).

From International school of subnuclear physics; Erice, Italy (14 Jul 1974).

See CONF-740731—.

Using hydrogen and deuterium fills of the 12-ft bubble chamber, events were observed of the single pion production reactions νp yields $\nu n\pi^+$, νp yields $\nu p\pi^0$, and νn yields $\nu p\pi^-$. The neutral currents are compared to those of the charged-current reaction νp yields $\mu^- p\pi^+$. All sources of possible background that could simulate the neutral current events are measured and so accounted for. In particular, the neutron background from reactions such as np yields $nn\pi^+$, which is completely determined, allows a detailed comparison with models of the neutral current process. The $p\pi^-$ mass spectrum shows no enhancement at the $\Delta(1236)$ mass. (auth)

STRONG BARYON-INDUCED INTERACTIONS

7701 (FERMILAB-Conf—75/76-THY) **Developments in strong interaction physics.** Quigg, C. (Fermi National Accelerator Lab., Batavia, Ill. (USA)). Sep 1975. 33p. (CONF-750858—15). Dep. NTIS $4.00.

From Meeting of the ASP division of particles and fields; Seattle, Washington, USA (27 Aug 1975).

Some recent results on high energy collisions are reviewed. Regularities of total and elastic cross sections are summarized in light of theoretical ideas. New indications of the structure of events with large transverse momentum particles receive brief attention. The general features of nondiffractive particle production are emphasized. (auth)

7702 (ORO—3956-3) **Bubble chamber studies of hadron and photon interactions. Progress report, June 1, 1972—May 31, 1973.** Bugg, W.M.; Condo, G.T.; Hart, E.L. (Tennessee Univ., Knoxville (USA)). 1973. Contract AT(40-1)-3956. 12p. Dep. NTIS $3.50.

Experimental research on strong interactions is summarized. (JFP)

7703 **Spin effects in proton—proton scattering.** Krisch, A.D. (Univ. of Michigan). pp 103-112 of In Proceedings of the ninth Recontre de Moriond. Vol. I. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris (1974).

From 9. Rencontre de Moriond conference; Meribel-les-Allues, France (3 Mar 1974).

See CONF-740332—P1.

An experiment was done using a polarized proton beam and a polarized proton target. The cross section for elastic proton—proton scattering at 6 GeV/c and P²/sub perpendicular to/ = 0.5 yields 1.6 (GeV/c)² was measured in several spin states. The cross sections were found to be unequal by up to a factor of 2. The significance of this spin dependence is discussed along with future plans. (auth)

7704 **Pion production in nucleon—nucleon collisions.** Stephenson, G.J. (Los Alamos Scientific Lab., NM). *AIP (Am. Inst. Phys.) Conf. Proc.*; No. 26, 55-62(1975).

From 6. international conference on high energy physics and nuclear structure; Santa Fe, New Mexico, USA (9 Jun 1975).

See CONF-750631—.

An idea of the quality of the data on pion production in N—N interactions is given, and attention is called to some regularities. (JFP)

7705 **Two-particle correlations in the central region of p-p interactions at 200 GeV/c.** Smith, G.A. (Michigan State Univ., East Lansing). pp 97-111 of In Proceedings of the 3rd international winter meeting on fundamental physics. Bejarano, J.D. (ed.). Madrid; Instituto de Estudios Nucleares (1975).

From 3. international meeting on fundamental physics; Sierra Nevada, Spain (10 Feb 1975).

See CONF-750242—.

Two-particle rapidity and transverse momentum correlations are studied in the central region for a high statistics sample of events produced in pp interactions at 200 GeV/c in the Fermilab 30-inch hydrogen bubble chamber. (auth)

7706 **Negative-hyperon production in high-energy proton interactions.** Hungerbuhler, V.; Majka, R.; Marx, J.N.; Nemethy, P.; Sandweiss, J.; Tanenbaum, W.; Willis, W.J.; Atac, M.; Ecklund, S.; Gollon, P.J.; Lach, J.; MacLachlan, J.; Roberts, A.; Stefanski, R.; Theriot, D.; Wang, C.L. (Yale University, New Haven, Connecticut 06520). *Phys. Rev., D;* **12**: No. 5, 1203-1210(1 Sep 1975).

Momentum spectra for forward Σ^- and Ξ^- production by protons on beryllium are presented. Σ^- production data for two primary proton momenta are compared to test scaling of the invariant cross section. In addition, the observed single-particle momentum distributions are compared with single-particle spectra from other inclusive reactions initiated by protons. (AIP)

7707 **Some features of the reaction pp yields Δ^{++}(1236)n at 6 GeV/c.** Mountz, J.D.; Smith, G.A.; Lennox, A.J.; Poirier, J.A.; Prukop, J.P.; Rey, C.A.; Sander, O.R.; Kirk, P.; Klem, R.D.; Spirn, I. (Department of Physics, Michigan State University, East Lansing, Michigan 48824). *Phys. Rev., D;* **12**: No. 5, 1211-1218(1 Sep 1975).

Approximately 12 000 examples of the reaction ppyieldsΔ^{++}(1236)n have been identified at 6 GeV/c in a spark-chamber experiment performed at the Argonne National Laboratory Zero Gradient Synchrotron. The experimental invariant-mass and momentum-transfer-squared distributions are in agreement with predictions of the Chew-Low one-pion-exchange model, suitably modified to account for form factors or absorption. The data have been extrapolated from the physical region to the pion pole. It is found that the Durr-Pilkuhn and Benecke-Durr models, in conjunction with quadratic extrapolations in t, reproduce the known on-mass-shell dependence of the cross section for the elastic π^+p scattering. (AIP)

7708 **Charged-particle multiplicity distribution in pd interactions at 300 GeV/c.** Sheng, A.; Firestone, A.; Peck, C.; Dzierba, A.; Anderson, E.W.; Crawley, H.B.; Kernan, W.J.; Canter, J.; Dao, F.T.; Mann, A.; Schneps, J.; Poucher, J.; Stone, S. (California Institute of Technology, Pasadena, California 91125). *Phys. Rev., D;* **12**: No. 5, 1219-1223(1 Sep 1975).

Charged-particle multiplicity distributions in 300-GeV/c pd interactions have been determined from an exposure of the Fermi National Accelerator Laboratory 30-in. bubble chamber. The data show clear evidence for double scattering inside the deuterium nucleus. We have been able to correct for the effects of the second scatters by using a simple semiempirical model. The resulting pp multiplicity distribution is in excellent agreement with the pp data obtained from a p-H_2 experiment at the same energy. The pn multiplicity distribution appears to be shifted from the pp distribution with <n/sub c/>/sub p/ = 7.84 +- 0.17. (AIP)

7709 **Charge structure of multiparticle final states in pp collisions at 102 and 400 GeV/c.** Bromberg, C.; Chaney, D.; Ferbel, T.; Jensen, T.; Schindler, R.; Slattery, P.; Weingarten, D.; Seidl, A.A.; VanderVelde, J.C. (University of Rochester, Rochester, New York 14627). *Phys. Rev., D;* **12**: No. 5, 1224-1231(1 Sep 1975).

We investigate the distribution of charge in events produced by pp collisions at 102 and 400 GeV/c. The data are from exposures of the Fermi National Accelerator Laboratory 30-in. bubble chamber. A comparison of the energy dependence of the data with Monte Carlo simulations of random charge distributions provides support for the hypothesis of local compensation of charge. Results on charge transfer are in qualitative agreement with predictions of an independent neutral-cluster emission model. (AIP)

7710 **Measurements of the magnetic dipole moments of the antiproton and the Σ^- hyperon.** Roberts, B.L.; Cox, C.R.; Eckhause, M.; Kane, J.R.; Welsh, R.E.; Jenkins, D.A.; Lam, W.C.; Barnes, P.D.; Eisenstein, R.A.; Miller, J.; Sutton, R.B.; Kunselman, A.R.; Powers, R.J.; Fox, J.D. (College of William and Mary, Williamsburg, Virginia 23185). *Phys. Rev., D;* **12**: No. 5, 1232-1246(1 Sep 1975).

The fine-structure splittings in atoms formed by stopping antiprotons in Pb and U and Σ^- hyperons in Pb and Pt have been measured. Since the fine structure is produced through the interaction of the magnetic dipole moment of the anti p or the Σ^- with the Coulomb field of the nucleus, a value for the magnetic moment can be determined from the splitting. The magnetic moment obtained for the p was (-2.819 +- 0.056) nuclear magnetons, which agrees well with the CPT prediction of -2.793 nuclear magnetons. The magnetic moment derived for the Σ^- was (-1.48 +- 0.37) nuclear magnetons, which is in agreement with the sign given by simple SU(3) theory, but differs somewhat from the value of -0.9 nuclear magnetons predicted by the theory with no mass breaking. (AIP)

7711 **Study of the reaction p + p yields $\Delta^{++}(1236)$ + X^0 at 205 GeV/c.** Barish, S.J.; Derrick, M.; Musgrave, B.; Schultz, P.; Whitmore, J.; Engelmann, R.; Kafka, T.; Pratap, M.; Field, R.D. (Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev., D;* **12**: No. 5, 1260-1271(1 Sep 1975).

We have studied inclusive $\Delta^{++}(1236)$ production for abs. value (t/sub pΔ) <1.0 (GeV/c)^2 in a 50000 picture exposure of the 30-inch hydrogen bubble chamber to a 205 GeV/c proton beam. The inclusive Δ^{++} cross section for one hemisphere in the center-of-mass system is (1.30 +- 0.14) mb. The mean charged multiplicity of the system recoiling off the Δ^{++} is in agreement with that for laboratory π^-p interactions at the same energy in the center-of-mass frame. The inclusive Δ^{++} production is compared to inclusive λ^0 and proton production in the same experiment. The connection between Δ^{++} production and diffraction is discussed. We find that not all Δ^{++} come from the decay of a diffractively-produced state. The P/subT/^{2} distribution for the Δ^{++} has a slope of (10.5 +- 0.9) (GeV/c)$^{-2}$ for P/sub T/^{2} approximately-less-than0.2 (GeV/c)^2. This slope, together with the decay angular distribution of the Δ^{++} at small momentum transfer, suggests a strong pion-exchange contribution to the inclusive process. We compare the data to the expectation of a triple-Regge model with rho- and π-exchange contributions. (AIP)

STRONG MESON-INDUCED INTERACTIONS

7712 (ANL/HEP/PR—75-54) **How to identify resonances above the phase-shift analyses region.** Yokosawa, A. (Argonne National Lab., Ill. (USA)). Jul 1975. Contract W-31-109-Eng-38. 17p. (CONF-750749—3). Dep. NTIS $3.50.

From Symposium on new directions in hadron spectroscopy; Argonne, Illinois, USA (8 Jul 1975).

Interesting regularities were observed in the πp backward elastic-scattering data at intermediate energies with respect to the effect of resonances. In addition, the reaction process is found to be peripheral. It is pointed out that one should be able to determine the properties of resonances above the region in which the phase-shift analyses were performed. (auth)

7713 (BNL—20574) **Total cross sections of K^-p and K^-d from 411 to 1065 MeV/c.** Carroll, A.S.; Chiang, I.H.; Kycia, T.F.; Li, K.K.; Mazur, P.O.; Michael, D.N.; Mockett, P.; Rahm, D.C.; Rubinstein, R. (Brookhaven National Lab., Upton, N.Y. (USA)). 1975. 6p. (CONF-750858—14). Dep. NTIS $4.50.

From Meeting of the ASP division of particles and fields; Seattle, Washington, USA (27 Aug 1975).

Total cross sections of K^-p and K^-d were measured between 411 and 1065 MeV/c with high statistical precision. In addition to the well known $\Lambda(1690)$, $\Sigma(1765)$ and the $\Sigma(1670)$, the data show indications of several possible structures in both I = 0 and I = 1 isotopic spin states. (auth)

7714 (CONF-750869—1) **Search for charm in 250 GeV/c π^-p interactions.** Harris, R.; Bogert, D.; Hanft, R. (Fermi National Accelerator Lab., Batavia, Ill. (USA); Florida State Univ., Tallahassee (USA)). 1975. 12p. Dep. NTIS $4.50.

From Division of particle and fields meeting; Seattle, Washington, USA (Aug 1975).

Inclusive cross sections are found for strange particle production in π^-p interactions at 250 GeV/c in a search for charmed particles using neutral particle decays in a bubble chamber. The results are preliminary, but at the present statistical level no evidence was found for charmed particle production. (JFP)

7715 (COO—3069-346) **K^-K^+ and $\pi^-\pi^+$ production in K^-p interactions at 13 GeV.** Brandenburg, G.W. (Massachusetts Inst. of Tech., Cambridge (USA). Lab. for Nuclear Science). 1975. 27p. (CONF-750749—2). Dep. NTIS $5.00.

From Symposium on new directions in hadron spectroscopy; Argonne, Illinois, USA (8 Jul 1975).

The description of the K^-p experiment includes the production of phi and rho^0 mesons, rho^0-ω interference, and S^* production. (JFP)

7716 (LBL—4249) **I. Pion charge-exchange at Fermilab, and II. Some remarks on hadron production at large transverse momenta.** Pripstein, M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1975. Contract W-7405-ENG-48. 57p. (CONF-7506106—1). Dep. NTIS $5.50.

From International summer school of particle physics; Montreal, Canada (16 Jun 1975).

The discussion of pion charge-exchange and hadron production at large transverse momenta includes the physics motivation, the experimental method event selection criteria, results for the reaction π^-p yields nπ^0(eta). (JFP)

7717 (LBL—4610) **Measurement of the π^-p yields π^0n and π^-p yields eta n differential cross sections at beam momenta from 20 to 200 GeV/c.** Johnson, R.A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1975. Contract W-7405-ENG-48. 97p. Dep. NTIS $6.00.

Thesis.

The results of a measurement of the π^-p yields π^0n and π^-p yields eta n differential cross sections at six pion beam momenta from 20 to 200 GeV/c are presented. The data for these cross sections were collected at the Fermi National Accelerator Laboratory in Batavia, Illinois. A 73.5 x 73.5 cm lead—scintillator hodoscope was used to detect the two photons from the decay of the π^0 and the eta; all other reactions were eliminated by detection of their charged particles and additional photons in an array of veto counters. The zero-degree charge exchange cross sections determined from these measurements are shown to be consistent with the measured π^+p and π^-p total cross section differences. Effective Regge trajectories for the rho and the A_2 also extracted from the data. 34 figures, 9 tables. (auth)

7718 **Low energy pion-nucleon and pion-deuteron interactions.** Burman, R.L. (Los Alamos Scientific Lab., NM). *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 26, 41-54(1975).

From 6. international conference on high energy physics and nuclear structure; Santa Fe, New Mexico, USA (9 Jun 1975).

See CONF-750631—.

In this survey one concentrates on current experiments in the fields of pion-nucleon and pion-deuteron interactions, for low energy incident pions—below 300 MeV. The discussion is mostly restricted to very recent work. The topics to be covered are: π/sup +-/p π^+d π/sup +-/p elastic scattering, π/sup +-/p π^+d π/sup +-/py bremsstrahlung, π^+d yields pp absorption, πd π^+d elastic scattering, and π^+d yields π^+pn breakup. (auth)

7719 **Study of the energy dependence of diffractive excitation in π^-p interactions up to Fermilab energies.** Smith, G.A. (Michigan State Univ., East Lansing). pp 141-155 of In Proceedings of the 3rd international winter meeting on fundamental physics. Bejarano, J.D. (ed.). Madrid; Instituto de Estudios Nucleares (1975).

From 3. international meeting on fundamental physics; Sierra Nevada, Spain (10 Feb 1975).

See CONF-750242—.

Using new data from 100 GeV/c π^-p interactions in the FNAL 30-inch hydrogen bubble chamber-wide gap spark chamber hybrid system, the results of a study of the energy and charged multiplicity dependence of both the π^- and proton single diffractive excitation cross sections are presented. Data on the leading particle effect in inclusive π^- production are studied from 16 to 150 GeV/c. (auth)

7720 **Measurement of the K/sub L/^{0}-p and K/sub L/^{0}-d total cross sections.** Cleland, W.E.; Goz, B.; Freytag, D.; Devlin, T.J.;

Esterling, R.J.; Vosburgh, K.G. (Department of Physics and Astronomy, University of Massachusetts, Amherst, Massachusetts 01002). *Phys. Rev., D;* **12**: No. 5, 1247-1259(1 Sep 1975).

Total cross sections have been measured for the transmission of long-lived neutral K mesons through hydrogen and deuterium. The momentum range for the K/sub L/^{0} was 130—550 MeV/c. The momentum of each detected kaon was measured by time of flight. The cross sections are consistent with earlier less precise results. Comparison of the K/sub L/^{0} cross sections is made with the results of several K-matrix fits to other KN data, and the K/sub L/^{0} total cross sections are compared with existing theoretical calculations for K$^-$d total cross sections. (AIP)

7721 Features of the π^+d yields $\pi^+\pi^+\pi^-$d reaction at 6 GeV/c. Diaz, J.; DiBianca, F.A.; Fickinger, W.J.; Malko, J.A.; Robinson, D.K.; Dado, S.; Engler, A.; Keyes, G.; Kraemer, R.W. (Case Western Reserve University, Cleveland, Ohio 44106). *Phys. Rev., D;* **12**: No. 5, 1272-1277(1 Sep 1975).

We have studied the coherent π^+dyields$\pi^+\pi^+\pi^-$d reaction using a sample of 4019 events having a visible final-state deuteron. The total cross section, corrected for invisible deuteron events, was found to be 380 +- 50 μb. The main features of the data are the large production rho^0 (90%), with a corresponding rho$^0\pi^+$ enhancement in the A_1 region, and the observation of the dπ enhancement at ~ 2.2 GeV. (AIP)

PARTICLE INTERACTIONS AND PROPERTIES - THEORETICAL

GENERAL

7722 (FERMILAB-Conf—75-78-THY) **Dimuon events.** Lee, B.W. (Fermi National Accelerator Lab., Batavia, Ill. (USA)). Oct 1975. 8p. (CONF-750955—2). Dep. NTIS $3.50.

From Conference on gauge theories and modern field theory; Boston, Massachusetts, USA (26 Sep 1975).

An understanding of dimuon events is given based on minimal gauge theory. Included are the definition of a dimuon event, the source of such events, gross features of the minimal model interpretation, consequences and predictions, exclusive channels, and dimuon events of the same sign. (JFP)

7723 Note on the detectability of charmed particles. Heusch, C.A. (Univ. of California, Santa Cruz). pp 644-649 of In Lepton and hardon structure. Vol. 12. Zichichi, A. (ed.). London; Academic Press Inc. (1975).

From International school of subnuclear physics; Erice, Italy (14 Jul 1974).

See CONF-740731—.

A discussion is given of the possible detection of the charmed quark including the reason for charm, the detection of charmed hadrons, the charm experiment of the Santa Cruz-SLAC collaboration, and what to look for. (JFP)

7724 Spontaneous CP nonconservation. Lee, T.D. (Columbia Univ., New York). pp 720-733 of In Lepton and hardon structure. Vol. 12. Zichichi, A. (ed.). London; Academic Press Inc. (1975).

From International school of subnuclear physics; Erice, Italy (14 Jul 1974).

See CONF-740731—.

The idea that the vacuum state, though Lorentz-invariant, may resemble a medium and that this may explain why there is a large variety of missing symmetries is illustrated by giving a simple example in connection with CP nonconservation. (JFP)

7725 Proposed medium interaction and the new mesons. Cung, V.K.; Kim, C.W.; Sato, A. (Department of Physics, The Johns Hopkins University, Baltimore, Maryland 21218). *Phys. Rev., D;* **12**: No. 5, 1433-1445(1 Sep 1975).

Under the assumptions that (1) the newly discovered particles with 3.1 and 3.7 GeV masses are bound states of a charmed quark and a charmed antiquark and (2) the Okubo-Zweig-Iizuka rule is valid exactly in the strong interaction, we propose a new fundamental interaction. This interaction is mediated by a triplet of chiral (V-A) SU(2) gauge bosons and has an effective strength between those of the electromagnetic and weak interactions. Decay properties of the new particles are investigated systematically. Also discussed are decay properties of charmed particles and a J/sup P/ = 0$^-$ charmed quark-antiquark bound state, as well as some consequences of the medium interaction in low energy. (AIP)

7726 Lepton coupling in the proposed medium interaction and breakdown of muon-electron universality. Kim, C.W.; Sato, A. (Department of Physics, The Johns Hopkins University, Baltimore, Maryland 21218). *Phys. Rev., D;* **12**: No. 5, 1446-1453(1 Sep 1975).

It is argued from analyses of experimental data that the gauge bosons B which mediate the proposed medium interactions may couple to a doublet of the muon and heavy muon but not to the electron. This conjectured μ-B gauge coupling seems to explain the apparent small breakdown of μ-e universality observed in elastic and inelastic μ+p scattering and leptonic decay of phi meson. The mass of B is estimated to be around 4 GeV. It is also shown that the anomalous bump (after psi and psi' are subtracted) indicated in muon pair production in high-energy hadron collisions can be explained qualitatively as an effect of muon pair production via a virtual B boson. Several other consequences of the μ-B coupling are discussed. (AIP)

ELECTROMAGNETIC INTERACTIONS

7727 (COO—1545-174) **Phenomenological bounds in inclusive neutrino interactions.** Aubrecht, G.J. II; Takasugi, E.; Tanaka, K. (Ohio State Univ., Columbus (USA). Dept. of Physics). 1975. Contract AT(11-1)-1545. 12p. Dep. NTIS $3.50.

Using expressions for the ν and anti ν charged and neutral current cross sections and the electroproduction structure function integral and positivity requirements of the sea contribution, bounds are obtained on sigma/sup anti nu N//sigma/sup anti nu N/, and sigma/sup anti nu N//sub nc//sigma/sup nu N//sub nc/ in the standard model. A bound on sigma/sup anti nu N//sigma/sup nu N/ obtained with a V + A term anti p'γ/sub mu/(1-γ_5)n is used to rule out such a term in the current. A plot of sigma/sup nu N//sub nc/ + sigma/sup anti nu N//sub nc/ versus sigma/sup nu N//sub nc/ - sigma/sup anti nu N//sub nc/ is introduced to analyze the neutral current data. A new relation connecting moments of y and y distributions at a particular point y/sub n/ for ν and anti ν interactions is found. The results do not depend on the neutral current data. (auth)

7728 Semilocal duality in π^0 photoproduction. Armenian, H.K.; Goldstein, G.R.; Rutherfoord, J.P.; Weaver, D.L. (Tufts University, Physics Department, Medford, Massachusetts 02155). *Phys. Rev., D;* **12**: No. 5, 1278-1282(1 Sep 1975).

It is found that a simple effective Regge parameterization of high-energy differential-cross-section data for π^0 photoproduction when extrapolated to energies below 3 GeV satisfactorily explains the small-abs. value (t) data, except for the first resonance, in the sense of semilocal duality. (AIP)

7729 Heavy quarks and long-lived hadrons. Appelquist, T.; Politzer, H.D. (Institute for Advanced Study, Princeton, New Jersey 08540). *Phys. Rev., D;* **12**: No. 5, 1404-1414(1 Sep 1975).

In a recent Letter we reported on some work which led us to suggest the possibility of narrow spikes in the e$^+$e$^-$ annihilation cross section into hadrons. In this paper, we discuss the theoretical infrastructure of this work more thoroughly, and improve and extend the calculations and experimental predictions. We examine a colored quark-gluon model of hadronic matter, with color an exact SU(3) gauge symmetry. In addition to the light quarks that make up ordinary hadrons, a heavy quark, such as the charmed c, is included. The narrow resonances recently discovered by the MIT-BNL and SLAC-LBL groups are interpreted as c anti c bound states (orthocharmonium). In this energy range, the effective coupling has become small according to asymptotic freedom, and many aspects of the bound-state structure can be calculated. The existence of 0$^-$ (paracharmonium) states is predicted, and decay widths and mass splittings are estimated. The total e$^+$e$^-$ cross section into hadrons is predicted to scale asymptotically, with an approach to scaling from above that can be calculated over a large energy range. (AIP)

7730 ω-mixing model for the production of nonhadronic psi's. Neff, T.L.; Sachrajda, C.; Sivers, D.; Townsend, J. (Center for Theoretical Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Phys. Rev., D;* **12**: No. 5, 1488-1491(1 Sep 1975).

We develop a simple, plausible model for the photoproduction and hadronic production of the psi(3100) under the assumption that this state is not a hadron. In particular, we find the cross section σ (γNyieldspsi N) is less than approx. 3 nb. Experimental results in this range will not unambiguously determine whether the psi is a hadron. (AIP)

7731 Is the relation R $\cong 16\pi^2$/f/sub rho/^{2} of physical significance. Terazawa, H. (The Rockefeller University, New York, New York 10021). *Phys. Rev., D;* **12**: No. 5, 1506-1507(1 Sep 1975).

It is shown that the present remarkable agreement between the previously predicted asymptotic limit R $\cong 16\pi^2$/f/sub rho/^{2} (=5.7 +- 0.9) of σ(e$^+$e$^-$yieldshadrons)/ σ (e$^+$e$^-$yields$\mu^+\mu^-$) and the recently reported SLAC-LBL e$^+$-e$^-$ colliding-beam data with R=5.1 +- 0.4 at 5 GeV center-of-mass energy is of physical sig-

nificance if R stays approximately constant for higher energies. (AIP)

WEAK INTERACTIONS

7732 Muon—nucleon scattering: search for hadron and lepton structure. Heusch, C.A. (Univ. of California, Santa Cruz). pp 650-670 of In Lepton and hardon structure. Vol. 12. Zichichi, A. (ed.). London; Academic Press Inc. (1975).

From International school of subnuclear physics; Erice, Italy (14 Jul 1974).

See CONF-740731—.

A few aspects of what can be learned from a detailed study of final-state particles of deeply inelastic lepton-nucleon scattering are studied. Results on the relative cross sections for one, three, ... charged hadrons in the final state and average charged multiplicities for the processes μ^+p are presented. It is noted that a number of intriguing features are beginning to emerge from precision studies of hadronic final states in lepton—nucleon scattering. (JFP)

7733 Consequences of neutrino production of M° heavy leptons. Albright, C.H. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510 and Northern Illinois University, DeKalb, Illinois 60115). *Phys. Rev., D;* **12**: No. 5, 1319-1328(1 Sep 1975).

Monte Carlo calculations are presented for neutrino production of neutral heavy leptons which rapidly decay into dimuons and neutrinos, neutrinos only, muons and hadrons, and neutrinos and hadrons. For a mass of 4—5 GeV, the relative cross sections, branching ratios, and observed energy, x, y, and W distributions are all presently compatible with the data on dimuon production and anomalous effects recently reported. (AIP)

7734 Comment on a recent search for charmed mesons. Einhorn, M.B.; Quigg, C. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510). *Phys. Rev. Lett.;* **35**: No. 16, 1114-1116(20 Oct 1975).

We assess the impact of the upper limits for production cross section times branching ratio of narrow mass peaks reported by Boyarski et al. on the hidden-charm interpretation of the new narrow resonances. (AIP)

STRONG INTERACTIONS, GENERAL

7735 Implications of parity violating effects in strangeness conserving nonleptonic processes. Herczeg, P. (Los Alamos Scientific Lab., NM). *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 26, 504-514(1975).

From 6. international conference on high energy physics and nuclear structure; Santa Fe, New Mexico, USA (9 Jun 1975).

See CONF-750631—.

The information one obtains from the various experimental results regarding the question of the origin of parity-violating effects in strangeness-conserving nonleptonic processes is discussed, and some theoretical ideas are reviewed that have recently been discussed in this connection. (JFP)

7736 Light-cone structure in the cavity approximation to the bag theory. Jaffe, R.L.; Patrascioiu, A. (Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Phys. Rev., D;* **12**: No. 5, 1314-1318(1 Sep 1975).

It is shown that the imposition of boundary conditions does not change the light-cone singularity of the free Dirac anticommutator function in three dimensions. A system of noninteracting quarks confined to a rigid cavity therefore exhibits Bjorken scaling. (AIP)

STRONG INTERACTIONS, BARYON NO. 0

7737 (COO—1764-237) Exotic N antiN resonances. Rosner, J.L. (Minnesota Univ., Minneapolis (USA). School of Physics and Astronomy). 1975. Contract AT(11-1)-1764. 14p. (CONF-750749—1). Dep. NTIS $4.50.

From Symposium on new directions in hadron spectroscopy; Argonne, Illinois, USA (8 Jul 1975).

Some possible suggestions for detecting exotic anti NN resonances are reviewed including the size of Reggeon-exchange contributions to baryon—anti baryon total cross sections, the smallness of S-wave annihilation rates, and the goodness of asymmetry description of N anti N annihilations at rest. (JFP)

7738 New particles. Gilman, F.J. (Stanford Univ., CA). *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 26, 331-350(1975).

From 6. international conference on high energy physics and nuclear structure; Santa Fe, New Mexico, USA (9 Jun 1975).

See CONF-750631—.

The properties of the new particles are reviewed in the context of the behavior of electron-positron annihilation into hadrons. The phenomenology of Psi(3100) and Psi'(3700) decays is discussed in some detail with emphasis on what the decays allow one to infer about the resonances, and on the difficulties which the observation and, more critically, the nonobservation of certain modes causes possible theories. (auth)

7739 Mass of the psi(3095) as an N anti N resonance. Mac Gregor, M.H. (Lawrence Livermore Laboratory, Livermore, California 94550). *Phys. Rev., D;* **12**: No. 5, 1492-1494(1 Sep 1975).

Guided by a suggestion that the psi(3095) is an N anti N resonance, and using the basis states of a previously-published light-quark model, we "calculate" the mass of the psi as 3105/sub -15//sup +5//MeV. The appearance of a narrow-width meson resonance at this mass value is consistent with a systematic formalism that was devised to generate the observed spectrum of lower-mass narrow-width meson resonances. However, the width of the psi is narrower by a factor of α^{-1}=137 than we would have anticipated on the basis of the light-quark model. The psi'(3684) resonance also fits into this formalism, but the mass of the psi' has a larger calculational uncertainty since it is above the N anti NN anti N threshold. (AIP)

7740 Comments on strongly interacting W-meson theories. Segre, G. (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19174). *Phys. Rev., D;* **12**: No. 5, 1499-1501(1 Sep 1975).

We discuss the phenomenology and possible neutral-current tests of theories in which the W mesons have strong as well as semiweak and electromagnetic interactions. We then show that, at least in one such model, divergence difficulties are still present in the usual way for amplitudes such as K/sub L/ yields $\mu^+\mu^-$. (AIP)

STRONG INTERACTIONS, BARYON NO. 1

7741 (COO—3533-61) Current status of baryon spectroscopy. Wali, K.C. (Syracuse Univ., N.Y. (USA). Dept. of Physics). Aug 1975. 28p. (CONF-750729—6; SU—4206-61). Dep. NTIS $4.00.

From New directions in hadron spectroscopy meeting; Argonne, Illinois, USA (7 Jul 1975).

In this review of baryon spectroscopy, the basic ideas of some of the current models and the experimental data for their claims to success are discussed including realistic or constituent quark models, experimental comparison, the experimental and theoretical basis for the assignments, algebraic quark models, and confinement schemes. (JFP)

7742 Pion—nucleon off-shell t-matrix in pion nucleus interactions. Gibbs, W.R. (Los Alamos Scientific Lab., NM). pp 205-225 of In Investigation of nuclear structure by scattering processes at high energies. Schopper, H. (ed.). Amsterdam; North-Holland Publishing Co. (1975).

From International school of nuclear physics, the investigation of nuclear structure by scattering processes at high energies; Erice, Italy (22 Sep 1974).

See CONF-7409109—.

The pion-nucleon half-off-shell t-matrix describes the pion-nucleon wave function at short distances. If one is to attempt to use pions to probe the short range nucleon—nucleon correlations in nuclei it is certainly necessary to understand the short range pion-nucleon interaction. Since the strongest multiple scattering occurs when the distance between scatterers is small it is possible that all cross sections are affected. The size of this effect and (to some extent) the degree of agreement with experiment is discussed. 15 figures. (auth)

7743 Amplitude analysis for the reaction π^+p yields$\pi^+\pi^-\pi^0\Delta^{++}$ at 7 GeV/c. Wagner, F.; Tabak, M.; Chew, D.M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). *Phys. Lett., B;* **58**: No. 2, 201-205(1 Sep 1975).

An amplitude analysis for the reaction π^+p yields $\pi^+\pi^-\pi^0\Delta^{++}$ at 7 GeV/c has been performed using the isobar model for the 3π system. The 3π-mass covers the range from 0.82 to 1.90 GeV. Strong A_2 production is observed. The spin parity of the $\omega^*(1700)$ is determined to be 3^-. No significant A_1 production can be seen. (NL)

STRONG INTERACTIONS, BARYON NO. GREATER THAN 1

7744 Nonperturbative three-dimensional formalism for the study of the nucleon—nucleon interaction. Klein, A.; Lee, T.H. (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19174). *Phys. Rev., C;* **12**: No. 5, 1381-1391(Nov 1975).

As an alternative to the dispersion theoretic approach to the two-nucleon interaction, we outline an improved version of an older method which derives both an interaction and the wave equation of which it is a part on an equal footing. This is done by reducing the Bethe-Salpeter equation to an equal time equation. The main improvement is that the interaction is given in nonperturbative form rather than as a sum of Feynman diagrams. As an illustration of the formalism, we test the validity of a simple version of the isobar model for the nucleon-nucleon problem and find it quantitatively inadequate. We discuss parenthetically how the existence of classes of reduction schemes is reflected as an ambiguity in the definition of the interaction. (AIP)

PARTICLE INVARIANCE PRINCIPLES AND SYMMETRIES

APPLICATIONS TO ELECTROMAGNETIC AND WEAK INTERACTIONS

7745 **Parity nonconservation in two-nucleon systems.** Nagle, D.E. (Los Alamos Scientific Lab., NM). *AIP (Am. Inst. Phys.) Conf. Proc.*; No. 26, 497-503(1975).

From 6. international conference on high energy physics and nuclear structure; Santa Fe, New Mexico, USA (9 Jun 1975).

See CONF-750631—.

The observation of a violation of the parity symmetry in two-nucleon systems implies the presence of a weak hadronic force. The positive effect reported by Lobashov et al. in the reaction np yields dγ, for the circular polarization of the gamma ray, would imply a large value for the parity nonconserving (PNC) amplitude. A transmission experiment was undertaken for 15-MeV longitudinally polarized protons on hydrogen. A transmission experiment for 6-GeV polarized protons on Be and on H_2O is in progress at the ZGS at Argonne National Laboratory. The current results of the latter two experiments are summarized, and the relation to theoretical calculations is discussed. (auth)

APPLICATIONS TO STRONG INTERACTIONS

7746 **Parity and time-reversal symmetries in nuclear systems.** Boehm, F. (California Inst. of Tech., Pasadena). *AIP (Am. Inst. Phys.) Conf. Proc.*; No. 26, 488-496(1975).

From 6. international conference on high energy physics and nuclear structure; Santa Fe, New Mexico, USA (9 Jun 1975).

See CONF-750631—.

In this lecture experimental evidence pertaining to the parity and time-reversal symmetries in nuclei and few-nucleon systems, as well as their theoretical implications are reviewed. My presentation will be restricted to hadronic systems only, leaving out such processes as nuclear beta decay or muon decay. (auth)

FIELD THEORY

7747 (COO—3069-339) **Quantum mechanical approximations in quantum field theory.** Jackiw, R. (Massachusetts Inst. of Tech., Cambridge (USA). Lab. for Nuclear Science; Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Physics). 1975. Contract AT(11-1)-3069. 47p. (CONF-750110—9; CONF-750125—2). Dep. NTIS $5.00.

From Orbis scientist meeting; Coral Gables, Florida, USA (21 Jan 1975).

Some cooperative, coherent effects in quantum field theory, such as spontaneous symmetry violation, bound states, and entrapment of various excitations, can be exposed only by approximation procedures which do not rely on analyticity or regularity in the coupling constant. These procedures are extended to relativistic quantum field theory. The following procedures are considered: Rayleigh—Ritz variation, self-consistent (Hartree—Fock) approach, semiclassical approximation, and the Kerman—Klein method (including generalized Tamm—Dancoff calculations; Hartree, Hartree—Fock, and Hartree—Fock—Bogolyubov techniques; and random phase approximation). The problems of symmetry behavior at zero and finite temperature, coherent bound states in field theory, and dynamical symmetry breaking are discussed. 4 figures. (RWR)

7748 **Multiparticle production in Reggeon field theory.** Bartels, J.; Rabinovici, E. (Fermi National Accelerator Lab., Batavia, Ill. (USA)). *Phys. Lett., B;* **58**: No. 2, 171-176(1 Sep 1975).

In the framework of reggeon field theory it is shown that multiparticle production processes with repeated Pomeron exchange satisfy unitarity constraints and avoid decoupling problems, for a small enough PPP coupling. For a large PPP coupling, the existence of a two-Pomeron bound state at j greater than 1 is discussed. It is also found that the leading contribution to sigma/sub ns/ behaves like sigma/sub els/. (NL)

7749 **Explicit calculation vs. formal proof concerning unitarity violation of unified theories in Wu's gauge.** Hsu, J.P. (Univ. of Texas, Austin). *Lett. Nuovo Cim.*; **14**: No. 12, 425-431(22 Nov 1975).

A formal proof and explicit check of unitarity for non-Abelian gauge theories with a particular bilinear gauge condition are presented. The theories are constructed within the Lagrange-multiplier formalism. It is concluded that the usual formalism for non-Abelian gauge theories is not completely satisfied because it leads to violation of unitarity when one uses the Wu-gauge condition. The Lagrange-multiplier formalism can reveal the stability of gauge conditions, if any, and has more general validity than the usual formalism. (JFP)

7750 **Representations of a local current algebra: their dynamical determination.** Menikoff, R.; Sharp, D.H. (Theoretical Division, Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87544). *J. Math. Phys. (N.Y.);* **16**: No. 12, 2341-2352(Dec 1975).

Local currents are used to describe nonrelativistic many-body quantum mechanics in the thermodynamic limit. The problem of determining a representation of the local currents corresponding to a given Hamiltonian is studied. We formulate the dynamics in such a way that one solves simultaneously for the ground state and the representation of the local currents. This leads to two coupled functional equations relating the generating functional to a functional which describes the ground state. Together these functionals determine a representation of the local currents in which the Hamiltonian is a well-defined operator. The functional equations are equivalent to a set of integro—differential equations for expansion coefficients of the two functionals. (AIP)

7751 **Approximate representations of a local current algebra.** Menikoff, R.; Sharp, D.H. (Theoretical Division, Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87544). *J. Math. Phys. (N.Y.);* **16**: No. 12, 2353-2360(Dec 1975).

An approximate method for dealing with nonrelativistic many-body quantum systems having short range interactions is developed using local currents. The scheme is based on determining approximate representations of subalgebras of the local currents. This mathematical framework is used to discuss several approximation schemes. (AIP)

NUCLEAR PHYSICS

7752 (ANL—75-75) **Physics Division annual review, 1 April 1974—31 March 1975.** Bollinger, L.M. (Argonne National Lab., Ill. (USA)). 1975. Contract W-31-109-Eng-38. 310p. Dep. NTIS $10.75.

Work is reported in the areas of intermediate-energy physics, heavy-ion physics, light-ion physics, accelerator operations, superconducting linac development, neutron physics, theoretical physics, and atomic and molecular physics. Lists of publications and staff members are also included. Much of the work reported has been or will be published. Unpublished research reports containing significant amounts of information are listed separately by title. (RWR)

7753 (COO—535-733) **Technical progress report and proposal for continuation of contract.** (Colorado Univ., Boulder (USA). Dept. of Physics and Astrophysics). 1 Nov 1975. Contract E(11-1)-535. 141p. Dep. NTIS $7.00.

A considerable amount of experimental work was done on the importance of two-step mechanisms in nuclear reactions. The medium-energy experimental group participated in construction of the EPICS facility at LAMPF. The theoretical program concentrated on investigations of π—nucleus interactions and finite-range effects. The report is arranged as follows: experimental program (nuclear physics, intermediate energy physics, apparatus and facility development, cyclotron operation, outside users of cyclotron facilities), theoretical program, publications and reports, and personnel. The nuclear physics section of the report contains work on charged-particle experiments (single-nucleon-transfer reactions, multinucleon-transfer reactions, charge-exchange reactions, elastic and inelastic scattering, charged-particle reaction studies on ^{14}C), gamma-ray experiments and beta decay, neutron time-of-flight experiments, x-ray fluorescence trace element analysis, and other activities. Seventeen items with significant amounts of data are listed separately by title. (RWR)

NEUTRON INTERACTIONS WITH MATTER

7754 (CONF-751006—15) **Theory of radiation induced defect production.** Robinson, M.T. (Oak Ridge National Lab., Tenn. (USA)). Oct 1975. 21p. Dep. NTIS $4.50.

From International conference on radiation damage in metals; Gatlinburg, Tennessee, USA (5 Oct 1975).

The theory of defect production in solids by neutron irradiation is reviewed, including discussions of the nuclear reactions which produce the primary recoils and the loss of energy from the displacement cascade by electron excitations. The theoretical predictions are compared with the limited available experiments on thermal and fast neutron irradiation. The results are in rough agreement in most instances, but further improvements in the theory are clearly needed. (auth)

7755 (CONF-751209—19) **Analysis of magnetic neutron scattering data.** Felcher, G.; Garland, J.W.; Cable, J.W.; Medina, R. (Oak Ridge National Lab., Tenn. (USA)). Dec 1975. 9p. Dep. NTIS $4.50.

From 21. annual conference on magnetism and magnetic materials; Philadelphia, Pennsylvania, USA (9 Dec 1975).

The determination of the proper magnetic form factors for use in the analysis of diffuse-scattering data is discussed, and that information which is immediately available from such data is considered. Apparent discrepancies between the results of diffuse scattering and diffraction experiments on ferromagnetic Ni-Cu alloys are resolved. It is shown that the data indicate that the negative spin density usually attributed to conduction electrons instead arises largely from the overlap of localized wavefunctions, as was first suggested by Moon. 3 figures. (auth)

7756 (LA—6105-MS) **Analytic transport theory solutions for steady sources in pure absorbers.** Lee, C.E. (Los Alamos Scientific Lab., N.Mex. (USA)). Oct 1975. Contract W-7405-ENG-36. 12p. Dep. NTIS $4.00.

The monoenergetic steady-state integral neutron transport equation is solved analytically for several simple source configurations for pure absorbers. Specifically, the scalar neutron flux, phi(r), is derived for configurations in cartesian geometry representing the point, infinite line, infinite plane, finite line, infinite ribbon, finite ribbon, infinite tube, and finite box sources. Some of these configurations (point, infinite line, and infinite ribbon sources) were investigated previously by Case, deHoffmann and Placzek and are reviewed here for completeness. The others are more complex and represent new analytic solutions against which multidimensional numerical transport calculational codes may be tested. (auth)

NUCLEAR PROPERTIES AND REACTIONS, A=1-5, THEORETICAL

NUCLEAR REACTIONS AND SCATTERING

7757 (ANL—75-75, pp 122-123) **Photodisintegration of the deuteron near threshold.** Jackson, H.E.; Holt, R.J.; Wilson, W.M. 1975.

In Physics Division annual review, 1 April 1974—31 March 1975.

7758 (ORO—4856-41) **Recoil and strong formfactor effects in mesonic exchange corrections on the charge distribution of ^{3}He and ^{3}H.** Kloet, W.M.; Tjon, J.A. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). Nov 1975. 14p. Dep. NTIS $3.50.

Effects of meson exchange on the charge distribution of ^{3}He and ^{3}H are determined, including intermediate nucleon-antinucleon states, pion-nucleon resonances and recoil effects. The role of a strong interaction form factor in these effects is discussed. The calculation is based on a tri-nucleon wave function obtained from the Reid soft core potential. (auth)

7759 **Observation of two photons in n—p capture.** Dress, W.B. Jr. (Oak Ridge National Lab., TN). *AIP (Am. Inst. Phys.) Conf. Proc.*; No. 26, 203-210(1975).

From 6. international conference on high energy physics and nuclear structure; Santa Fe, New Mexico, USA (9 Jun 1975).

See CONF-750631—.

The observation of two gamma rays in coincidence following the capture of subthermal neutrons by protons in water is reported. The measured branching ratio of two-gamma events to single gamma events in the energy range of 600 to 1620 keV was found to be 0.0011 +- 0.0002. Possible sources of systematic error are also considered. (auth)

NUCLEAR PROPERTIES AND REACTIONS, A=1-5, EXPERIMENTAL

NUCLEAR REACTIONS AND SCATTERING

7760 (DP-MS—75-95) **Photoneutron cross sections for D_2O and beryllium.** Bowsher, H.F.; Woods, F.J.; Baumann, N.P. (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Lab.). 1975. Contract AT(07-2)-1. 11p. (CONF-751147—1). Dep. NTIS $4.50.

From American Physical Society Southeastern Sectional meeting; Auburn, Alabama, USA (13 Nov 1975).

The photodissociation cross section by ^{24}Na gamma rays was measured for deuterium in order to resolve a discrepancy between earlier measurements (1.43 to 1.59 millibarns) and a more recently reported one (1.34 mb). The measurement of the beryllium (γ,n) cross section for ^{24}Na gamma rays was also included as a check. Results for deuterium (1.54 mb) are in agreement with the earlier values. (SDF)

7761 (LBL—3849) **Nucleus—nucleus total cross sections for light nuclei at 1.55 and 2.89 GeV/C/nucleon.** Jaros, J.A. (California Univ., Davis (USA). Dept. of Engineering). Nov 1975. Contract W-7405-ENG-48. 121p. Dep. NTIS $6.50.

Thesis.

Total cross sections have been measured for protons, deuterons, alphas, and ^{12}C on hydrogen, deuterium, helium, and carbon targets at 1.55 and 2.89 GeV/c/nucleon using the "good geometry" transmission method. In addition, the inelastic cross sections and elastic slope parameters were measured for reactions initiated by deuterons, alphas, and ^{12}C. The factorization relation sigma/sub T/(AA) = sigma/sub T/(AB)^2/sigma/sub T/(BB) is violated for some of these reactions. The results generally agree with Glauber theory predictions except in their detailed energy behavior. It is found that sigma/sub T/ approximately equal to 144 (A/sub T//sup $^1/_3$/ + A/sub P//sup $^1/_3$/ - 1.48)^2 and sigma/sub IN/ approximately equal to 78 (A/sub T//sup $^1/_3$/ + A/sub P//sup $^1/_3$/ - 1.25)^2, where A/sub T/(A/sub P/) is the atomic mass number of the target (projectile) and the cross sections are given in mb. (auth)

7762 (LBL—4000, pp 59-60) **Polarization effects in the nucleon—deuteron breakup reaction.** Conzett, H.E. (Univ. of Basel); Rad, F.N.; Roy, R.; Birchall, J. Jul 1975.

In Nuclear chemistry. Annual report, 1974.

7763 (ORO—4699-2) **Study of the two-body dissociation of light nuclei in nuclear fields. Progress report, January 1, 1975—December 31, 1975.** Kirk, P.N.; Huggett, R.W. (Louisiana State Univ. and Agricultural and Mechanical Coll., Baton Rouge (USA)). 1975. 29p. Dep. NTIS $5.00.

The objective of the experiment is to measure the frequency with which nucleons within a parent nucleus coalesce into clusters. The experiment will be carried out at the Bevatron with heavy ion beams of 2.1 GeV per nucleon. The extracted heavy ion beam will be directed onto a target in which many interactions will occur. The interactions of interest will be those in which the incident nucleus fragments into two daughter nuclei. These events will be selected from the background by scintillation counters and associated fast electronics. A list of projects started or completed at LSU the past year is given. (auth)

7764 **Cross section of slow neutrons on parahydrogen.** Callerame, J.; Larson, D.J.; Lipson, S.J.; Wilson, R. (Harvard University, Cambridge, Massachusetts 02138). *Phys. Rev., C;* **12**: No. 5, 1423-1427(Nov 1975).

The total cross section of slow neutrons on gaseous parahydrogen has been measured at several temperatures near 20°K and with pressures ranging from 250 to 750 Torr. A previous experiment had suggested that the cross section would exhibit a significant pressure dependence. However, no such pressure dependence was observed. The data give a value for the neutron-proton coherent scattering length of (-3.733 +- 0.004) x 10^{-13} cm, in agreement with the latest liquid mirror measurements. (AIP)

7765 **Cross section of slow neutrons on orthodeuterium.** Callerame, J.; Larson, D.J.; Lipson, S.J.; Wilson, R. (Harvard University, Cambridge, Massachusetts 02138). *Phys. Rev., C;* **12**: No. 5, 1428-1431(Nov 1975).

The total cross section of slow neutrons on gaseous orthodeuterium has been measured near 22 K and at pressures ranging from 145 to 300 Torr. The results give rise to a set of values for the neutron-deuteron scattering lengths that are in significant disagreement with the latest liquid mirror measurements. The relationship between the scattering lengths was found to be: $(2a_4 + a_2)^2 + (5/4)(a_4 - a_2)^2 = (2.313 +- 0.003) \times 10^{-24}$ cm^2. (AIP)

NUCLEAR PROPERTIES AND REACTIONS, A=6-19 THEORETICAL

ENERGY LEVELS AND TRANSITIONS

7766 (ANL—75-75, pp 171-172) **Non-normal parity states in light nuclei.** Kurath, D.; Millener, D.J. 1975.
In Physics Division annual review, 1 April 1974—31 March 1975.

NUCLEAR REACTIONS AND SCATTERING

7767 **Resonating-group study of N + ^{16}O scattering with a generator-coordinate technique.** Thompson, D.R.; Tang, Y.C. (School of Physics and Astronomy, University of Minnesota, Minneapolis, Minnesota 55455). *Phys. Rev., C;* **12**: No. 5, 1432-1446(Nov 1975).
The scattering of nucleons by ^{16}O is studied with the resonating-group method. The ^{16}O wave function used is a translationally invariant antisymmetrized product of single-particle wave functions of $(1s)^4(1p)^{12}$ configuration in a harmonic-oscillator well having an appropriately chosen width parameter. A generator-coordinate technique is employed to facilitate the computation of the nonlocal interaction between the nucleon and the ^{16}O nucleus. This technique is discussed in some detail in order to demonstrate its utility in a nuclear problem involving a relatively large number of nucleons. Calculated results are compared with experimental data over a wide range of energies, and it is found that the agreement is in general quite satisfactory. Also, the result shows that in this particular problem the heavy-particle pickup process, which is properly taken into consideration by the use of a totally antisymmetric wave function, has a relatively small contribution. (AIP)

NUCLEAR PROPERTIES AND REACTIONS, A=6-19, EXPERIMENTAL

RADIOACTIVE DECAY

7768 **Half-lives of ^{18}Ne and ^{20}F.** Alburger, D.E.; Calaprice, F.P. (Brookhaven National Laboratory, Upton, New York 11973). *Phys. Rev., C;* **12**: No. 5, 1690-1691(Nov 1975).
The half-lives of ^{18}Ne and ^{20}F have been measured by multiscaling β rays detected in a plastic scintillator. ^{18}Ne was formed in the ^{16}O(^{3}He, n)^{18}Ne reaction at E/sub ^{3}He/ =5.7 MeV using a Ta_2 $^{16}O_5$ target depleted in ^{17}O and ^{18}O. ^{20}F was produced in the ^{19}F(d, p)^{20}F reaction with 2.0-MeV deuterons on a BaF_2 target. Half-life values of 1.669 +- 0.004 sec for ^{18}Ne and 10.996 +- 0.020 sec for ^{20}F were obtained. Using the present and other recent results the A=18 β decay mirror asymmetry is found to be -0.86 +- 0.80%. (AIP)

ENERGY LEVELS AND TRANSITIONS

7769 **E1 excitations in A = 15 nuclei.** Harakeh, M.H.; Paul, P.; Kuan, H.M.; Warburton, E.K. (Physics Department, State University of New York, Stony Brook, New York 11794). *Phys. Rev., C;* **12**: No. 5, 1410-1422(Nov 1975).
The ^{14}C(p,)^{15}N reaction was studied from E/sub p/ = 2.8 to 30 MeV corresponding to E/sub x/ = 13 to 38 MeV in ^{15}N covering the region of the lowest T = 3/2 states as well as the giant dipole resonance (GDR). The ^{14}N(p, γ)^{15}O reaction measurements were extended for excitation regions from E/sub x/ = 24 to 33.5 MeV, thus covering the analogous regions in ^{15}O and ^{15}N. Angular distributions obtained in the first reaction at the resonance energies of E/sub p/ = 4.83, 5.62, 6.65, 6.925, 10.0, 11.0, 12.35, 13.6, and 16.4 MeV indicated large negative a_2 coefficients in all cases. The new narrow (Γ/sub c.m./) = 90 keV) resonance at 6.925 MeV has J/sup π/ = 3/2$^+$ and T = 1/2. A careful comparison of the ^{15}N(γ, p_0)^{14}C and ^{15}O(γ, p_0)^{14}N reactions is used to extract the T = 3/2 and 1/2 components of the GDR in A = 15. Most of the T = 3/2 E1 strength is located near E/sub x/ = 26 MeV. A microscopic calculation of J/sup π/ < or = 5/2$^-$ states with T = 1/2 and 3/2 in a 2h-1p and 1h basis of good isospin gives good agreement with the observed depleted B(E1) values from the lowest T = 3/2 states and reproduces the location of the collective T = 3/2 E1 states near 26 MeV. It also describes well the distribution of T = 1/2 collective E1 strength. Using this agreement with the theory, which contains no adjusted parameters an effective symmetry potential of U = 28 MeV is extracted from the isospin energy splitting. This value is smaller than the typical 60 MeV found in heavier nuclei but agrees with a recent model-independent limit and with other cases of absolute value T/sub z/ vertical-bar = 1/2 nuclei. (AIP)

NUCLEAR REACTIONS AND SCATTERING

7770 (ANL—75-75, pp 85-86) **Cross sections for neutrons from ^{6}Li+d reactions at low energies.** Elwyn, A.J.; Holland, R.E.; Lynch, F.J.; Monahan, J.E.; Mooring, F.P. 1975.
In Physics Division annual review, 1 April 1974—31 March 1975.

7771 (LBL—4000, pp 87-88) **α-transfer studies via the (α,^{8}Be reaction on ^{15}N and ^{14}N.** Wozniak, G.J. (Nuclear Structure Lab., Oxford); Jelley, N.A.; Cerny, J.
In Nuclear chemistry. Annual report, 1974.

7772 (LBL—4000, pp 77-79) **Energy variation of multinucleon transfer reactions with heavy ions.** Scott, D.K. (Hahn—Meitner Institut, Berlin); Hendrie, D.L.; Jahnke, U.; Kraus, L.; Maguire, C.F.; Mahoney, J.; Terrien, Y.; Yagi, K. Jul 1975.
In Nuclear chemistry. Annual report, 1974.

7773 (LBL—4000, pp 83-84) **^{7}Li + ^{7}Li reaction studies leading to multi-neutron final stages.** Cerny, J. (Univ. of Oxford); Weisenmiller, R.B.; Jelley, N.A.; Wilcox, K.H.; Wozniak, G.J. Jul 1975.
In Nuclear chemistry. Annual report, 1974.

7774 (LBL—4000, pp 84-85) **Study of T = 2 states in ^{12}C and ^{12}B.** Ashery, D. (Tel-Aviv Univ., Israel); Goth, G.W.; Wozniak, G.J.; Zisman, M.S.; Cerny, J. Jul 1975.
In Nuclear chemistry. Annual report, 1974.

7775 (LBL—4000, pp 86) **Is (α,^{8}Be) a direct reaction at high energies:.** Jelley, N.A. (Nuclear Structure Lab., Oxford); Wozniak, G.J.; Cerny, J. Jul 1975.
In Nuclear chemistry. Annual report, 1974.

7776 (LBL—4000, pp 89-92) **Spectroscopic studies in the 1p-shell by the (^{6}Li,^{8}B) reaction.** Weisenmiller, R.B. (Nuclear Structure Lab., Oxford); Wilcox, K.H.; Jelley, N.A.; Wozniak, G.J.; Ashery, D.; Cerny, J. Jul 1975.
In Nuclear chemistry. Annual report, 1974.

7777 (LBL—4000, pp 124-126) **Excitation functions for simple pion induced nuclear reactions on ^{14}N, ^{16}O, and ^{19}F.** Jacob, N.P. Jr.; Markowitz, S.S. Jul 1975.
In Nuclear chemistry. Annual report, 1974.

7778 **Angular distributions in the radiative capture of 14 MeV neutrons.** Drake, D.M. (Los Alamos Scientific Labs., NM); Arthur, E.D.; Halpern, I. pp 227-232 of Petten, Netherlands; Reactor Centrum Nederland (1975).
From 2. international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974).
See CONF-740920—.
Relative yields of capture photons have been observed at 55, 90, and 125° for four nuclei in bombardments with 14 MeV neutrons. The yields from ^{10}B, ^{29}Si, and ^{40}Ca show little fore-aft anisotropy in contrast with those observed in proton capture, which generally peak forward. Neutron capture in ^{12}C is found to peak backward, suggesting the existence of a broad E2 resonance below the GDR. (auth)

NUCLEAR PROPERTIES AND REACTIONS, A=20-38, EXPERIMENTAL

ENERGY LEVELS AND TRANSITIONS

7779 (ANL—75-75, pp 70, 72, 73) **Decay of the t/sub 1/2/ = 22 μs isomeric state of ^{38}K.** Yates, S.W.; Lynch, F.J.; Holland, R.E.; Ahmad, I.; Friedman, A.M. 1975.
In Physics Division annual review, 1 April 1974—31 March 1975.

NUCLEAR REACTIONS AND SCATTERING

7780 (LBL—4000, pp 123-124) **Nuclear reactions of C, Al, and F with relativistic heavy ions at the Bevalac.** Murphy, D.L.; Markowitz, S.S. Jul 1975.
In Nuclear chemistry. Annual report, 1974.

7781 **Total yield measurements in $^{23}Na(p,\gamma)^{24}Mg$.** Switkowski, Z.E.; O'Brien, R.; Smith, A.K.; Sargood, D.G. (Univ. of Melbourne): *Aust. J. Phys.*; **28**: 141-153(1975).

The reaction $^{23}Na(p,\gamma)^{24}Mg$ has been investigated in the proton energy range 0.25-2.5 MeV. Total γ-ray strengths were determined for 64 resonances. A yield curve was measured over the range 0.65-2.55 MeV, and an estimate of the nonresonant cross section was obtained. Total resonance widths were deduced for 32 levels. (auth)

7782 **Cross-section measurement of (n,p) reactions for ^{27}Al, $^{46,47,48}Ti$, $^{54,56}Fe$, ^{58}Ni, ^{59}Co, and ^{64}Zn from near threshold to 10 MeV.** Smith, D.L.; Meadows, J.W. (Argonne National Lab., IL). *Nucl. Sci. Eng.*; **58**: No. 3, 314-320(Nov 1975).

Cross sections for the $^{27}Al(n,p)^{27}Mg$, $^{46,47,48}Ti(n,p)^{46,47,48}Sc$, $^{54,56}Fe(n,p)^{54,56}Mn$, $^{58}Ni(n,p)^{58}Co$, $^{59}Co(n,p)^{59}Fe$, and $^{64}Zn(n,p)^{64}Cu$ reactions were measured by activation methods for neutron energies from near threshold to 10 MeV. The cross sections were determined relative to ^{235}U and ^{238}U fission cross sections. The data are compared with values from the literature. (auth)

NUCLEAR PROPERTIES AND REACTIONS, A=39-58, THEORETICAL

ENERGY LEVELS AND TRANSITIONS

7783 **Thermal and low-energy neutron capture gamma-ray and conversion-electron spectroscopy in vibration-like nuclei.** Seyfarth, H. (Institut fuer Kernphysik, Juelich, Ger.). pp 166-180 of In Problems of vibrational nuclei. Alaga, G. (ed.). Amsterdam; North-Holland Publishing Co. (1975).

From Conference on vibrational nuclei; Zagreb, Yugoslavia (23 Sep 1974).

See CONF-740992—.

In contrast to the deformed nuclei which are rather well described by the advanced rotational models most of the vibrational or vibration-like nuclei are far from being understood, even if they are near to closed shells. To test the reliability of theoreical predictions, it is necessary to get complete data using all possible ways of excitation and all feasible experimental techniques. What can be contributed to the understanding of vibration-like nuclei by means of neutron-capture reaction studies is discussed. The emphasis is put on the question which data can be obtained complementary to those obtained from the radioactive decay or heavy-ion and particle-induced reactions. The first part contains a survey of the present techniques used in (n,γ) and (n,e^-) studied, demonstrated by characteristic examples. In the second part the recent data for a few specific nuclei of interest are discussed and compared to the results of model calculations. Some suggestions are made for the further work from both the experimental and theoretical point of view. 2 tables, 7 figures. (auth)

MOMENTS AND SPIN

7784 **Role of consistency effects on the antishielding of nuclear quadrupole moments: comparison between diagrammatic and differential-equation approaches for the ferric ion.** Ray, S.N. (State Univ. of New York, Albany); Lee, T.; Das, T.P.; Sternheimer, R.M.; Gupta, R.P.; Sen, S.K. *Phys. Rev., A;* **11**: No. 6, 1804-1809(Jun 1975).

A detailed comparison is carried out between consistency contributions to the nuclear quadrupole antishielding factor for the Fe^{+3} ion obtained by the linked-cluster many-body perturbation procedure, as well as a procedure employing perturbed wave functions used in conventional differential-equation procedures for studying antishielding factors. The agreement between results by the two procedures is found to be good, indicating that the procedure using perturbed wave functions is a viable one for studying consistency effects, at least for positive ions. 3 tables (auth)

NUCLEAR REACTIONS AND SCATTERING

7785 **Analysis of high energy heavy-ion transfer reactions.** Scott, D.K. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). pp 165-193 of In Classical and quantum mechanical aspects of heavy ion collisions. Harney, H.L. (ed.). Berlin; Springer-Verlag (1975).

From Classical and quantum mechanical aspects of heavy ion collisions; Heidelberg, F.R. Germany (2 Oct 1974).

NUCLEAR PROPERTIES AND REACTIONS, A=39-58, EXPERIMENTAL

ENERGY LEVELS AND TRANSITIONS

7786 **Lifetimes of the 2893- and 3464-keV levels of ^{40}Ar.** Warburton, E.K.; Olness, J.W.; Kolata, J.J. (Brookhaven National Laboratory, Upton, New York 11973). *Phys. Rev., C;* **12**: No. 5, 1392-1395(Nov 1975).

The recoil-distance method has been used in conjunction with the $^{37}Al(^{18}O, p\alpha)^{40}Ar$ and $^{37}Cl(\alpha, p)^{40}Ar$ reactions to measure mean lifetimes of 4.2 +- 2.0 and 930 +- 50 ps for the ^{40}Ar 2893- and 3464-keV levels, respectively. The excitation energies of these two levels were deduced to be 2892.60 +- 0.11 and 3464.48 +- 0.13 keV, respectively. The 3464-keV level is assigned J/sup π/ = 6^+ on the basis of the lifetime, the γ-ray angular distribution, and previous $^{38}Ar(t, p)^{40}Ar$ results. The E2 transition strengths of the ^{40}Ar 0^+-2^+-4^+-6^+ ground-state band are compared to those of ^{42}Ca and to shell-model calculations. (AIP)

NUCLEAR REACTIONS AND SCATTERING

7787 (ANL—75-75, pp 18-19) **Study of single-nucleon transfer systematics in heavy-ion-induced reactions.** Eisen, Y.; Fortune, H.T.; Henning, W.; Kovar, D.G.; Vigdor, S.E.; Zeidman, B. 1975.

In Physics Division annual review, 1 April 1974—31 March 1975.

7788 (ANL—75-75, pp 20, 22, 23) **Studies of ^{16}O-induced "α-particle" transfer on calcium isotopes.** Eisen, Y.; Erskine, J.R.; Fortune, H.T.; Greenwood, L.R.; Henning, W.; Kovar, D.G.; Vigdor, S.E.; Zeidman, B. 1975.

In Physics Division annual review, 1 April 1974—31 March 1975.

7789 (ANL—75-75, pp 22, 24-26) **Studies of two-nucleon transfer reactions in the scattering of ^{16}O from ^{44}Ca and ^{42}Ca.** Eisen, Y.; Fortune, H.T.; Henning, W.; Kovar, D.G.; Vigdor, S.E.; Zeidman, B. 1975.

In Physics Division annual review, 1 April 1974—31 March 1975.

7790 (ANL—75-75, pp 27-29) **L dependence in angular distributions of the two-proton transfer reaction $^{48}Ca(^{16}O,^{14}C)^{50}Ti$.** Erskine, J.R.; Henning, W.; Kovar, D.G.; Zeidman, B. 1975.

In Physics Division annual review, 1 April 1974—31 March 1975.

7791 (ANL—75-75, pp 35-36) **Optical potential in heavy-ion transfer reactions.** Eisen, Y.; Erskine, J.R.; Henning, W.; Kovar, D.G.; Zeidman, B. 1975.

In Physics Division annual review, 1 April 1974—31 March 1975.

7792 (ANL—75-75, pp 37, 39-40) **Cross sections for reactions induced by ^{16}O on Ca isotopes.** Eisen, Y.; Fortune, H.T.; Henning, W.; Kovar, D.G.; Vigdor, S.E.; Zeidman, B. 1975.

In Physics Division annual review, 1 April 1974—31 March 1975.

7793 (LBL—4000, pp 67-70) **Two proton transfer on ^{54}Fe studied with high energy heavy ion reactions (^{16}O, ^{14}C) and (^{12}C, ^{10}Be).** Homeyer, H. (Hahn—Meitner Institut, Berlin); Becchetti, F.D.; Harvey, B.G.; Hendrie, D.L.; Kover, D.G.; Mahoney, J.; von Oertzen, W. Jul 1975.

In Nuclear chemistry. Annual report, 1974.

7794 **Review of correlation data: departures from the statistical model.** Mughabghab, S.F. (Brookhaven National Lab., Upton, NY). pp 53-79 of In Neutron capture gamma-ray spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2. international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974).

See CONF-740920—.

Gamma-ray spectra due to radiative neutron capture in the thermal and resonance region are examined for nonstatistical effects. The data appear to be consistent with the interpretation that generally direct hard sphere capture dominates in the thermal region for A less than or equal to 46 while valence capture plays a

significant and sometimes dominant role in the vicinity of the peaks of the 2p, 3s and 3p single particle giant resonances. Additional evidence of valence capture is provided by data on ^{24}Mg, ^{38}Ar, and ^{54}Fe. On the other hand, correlations between partial radiative widths and either the (d,p) spectroscopic factors or the reduced neutron widths are reported. Since the magnitude of the valence neutron contribution cannot account for these observations, the doorway state picture is invoked. 18 figures, 50 references. (auth)

7795 **Enhanced transitions in the (n,γ) reaction to collective 3$^-$ states in nuclei near closed neutron shells.** Kane, W.R. (Brookhaven National Lab., Upton, NY). pp 181-185 of In Neutron capture gamma-ray spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2. international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974).

See CONF-740920—.

Exceptionally strong primary transitions occur in the (n,gamma) reaction to collective octupole states in even-even nuclei near closed neutron shells. The possible relevance of this effect to direct capture and doorway states in these nuclei is discussed. (auth)

7796 **1$^+$ states in ^{58}Ge.** Raman, S.; Slaughter, G.G.; Good, W.M.; Harvey, J.A.; McGrory, J.B.; Larson, D. (Oak Ridge National Lab., TN). pp 277-279 of In Neutron capture gamma-ray spectoscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2. international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974).

See CONF-740920—.

Levels in ^{58}Fe have been investigated via the ^{57}Fe(n,γ) reaction with neutrons below 30 keV. Results for the 3.97 keV, 0$^-$ resonance, when combined with previously known circular polarization results, lead to twelve 1$^+$ states in ^{58}Fe below 5.3 MeV. Good agreement is found between the experimental level spectrum and a theoretical one based on the shell model. (auth)

7797 **Threshold photoneutron spectra.** Jackson, H.E. (Argonne National Lab., IL). pp 437-458 of In Neutron capture gamma-ray spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2. international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974).

See CONF-740920—.

Photoneutron spectra in the resolved resonance region near threshold are reviewed as a tool for the study of the neutron capture reaction mechanism. Recent measurements of the photodisintegration of the deuteron near threshold suggest discrepancies with the elementary model of the reaction. Data for nuclei in the mass region A approximately 50 to 60 contain partial width correlations and non-resonant reaction components characteristic of channel capture. Other nuclear structure effects in the form of intermediate structure and partial width correlations for heavier nuclei are also discussed. Photon strength functions for E1 and M1 radiation resulting from measurement of threshold photoneutron spectra are compared with data from other sources and theoretical predictions. Intense p-wave photoneutron emission by the Pb isotopes indicates the presence of a magnetic dipole giant resonance whose integrated strength is close to the theoretical limit. 17 figures, 1 table. (auth)

7798 **Transfer of three identical nucleons in ^{16}O + ^{48}Ca.** Fortune, H.T.; Henning, W.; Kovar, D.C.; Zeidman, B.; Eisen, Y. (Argonne National Lab., Ill. (USA)). *Phys. Lett., B;* **57**: No. 5, 445-446(4 Aug 1975).

In the bombardment of ^{48}Ca by ^{16}O ions, three-proton "stripping" and three-neutron "pickup" reactions are observed with total yields approximately 45 μb and 5 μb, respectively. (auth)

NUCLEAR PROPERTIES AND REACTIONS, A=59-89, THEORETICAL

ENERGY LEVELS AND TRANSITIONS

7799 (IFA-SR—13-1975) **Computer program for simulation of Moessbauer relaxation spectra.** Barb, D.; Diamandescu, L. (Institutul de Fizica Atomica, Bucharest (Romania)). 1975. 14p. Dep. NTIS (US Sales Only) $3.50.

A program for simulation of Moessbauer spectra in the presence of electronic relaxation is reported. The program can be used for any $^3/_2$ yields $^1/_2$ nuclear transitions and electronic effective spin Seff = $^5/_2$. 6 figures, 1 table. (auth)

NUCLEAR REACTIONS AND SCATTERING

7800 **Comment on the existence of lower angular momentum cutoff in the fusion of heavy ions.** Natowitz, J.B.; Namboodiri, M.N. (Cyclotron Institute and Department of Chemistry, Texas A and M University, College Station, Texas 77843). *Phys. Rev., C;* **12**: No. 5, 1678-1679(Nov 1975).

Gauvin et al. have suggested that one possible explanation for the high thresholds of the reactions ^{74}Ge(^{84}Kr, xn)/sup 158-x/Er is the existence of a lower limit to the angular momentum of the compound system formed in the fusion step. We note that such lower limits have, in fact, previously been observed in the collisions of water droplets. Investigation of such lower limits may provide interesting new information on nuclear properties. (AIP)

NUCLEAR PROPERTIES AND REACTIONS, A=59-89, EXPERIMENTAL

RADIOACTIVE DECAY

7801 (COO—3246-15) **Research in nuclear chemistry. Annual progress report, September 15, 1974—September 14, 1975.** Kaplan, M. (Carnegie-Mellon Univ., Pittsburgh, Pa. (USA). Dept. of Chemistry). Jul 1975. Contract AT(11-1)-3246. 73p. Dep. NTIS $5.50.

The nuclear chemistry research program at Carnegie-Mellon University includes studies of nuclear reactions induced by heavy ions, nuclear properties, nuclear transitions and decay, and the hyperfine interactions of nuclear moments with extranuclear environments. Gamma-ray angular correlation measurements in the decay of ^{75}Se have been carried out, and the data indicate absence of appreciable perturbation in the $^5/_2^-$ intermediate nuclear state in ^{75}As. Integral and time-differential perturbed-angular-correlation experiments in ^{181}Ta have elucidated strong quadrupolar interaction effects in several compounds. The origins of the observed electric field gradients are traceable to chemical bonding effects. Studies have been made of the evaporation residues from complete fusion reactions induced by heavy ion beams in several target nuclei, using a new experimental technique. Measurements of energy spectra, angular distributions, and total cross-sections for these processes have been carried out for ^{16}O + ^{27}Al, ^{20}Ne + Cu, and ^{20}Ne + In. Proton evaporation spectra in coincidence with evaporation residues were determined in one case. In other studies, light fragments from the reaction of ^{12}C with ^{65}Cu were identified in a counter telescope, and cross sections for production of boron isotopes were determined by integration of the measured angular distributions of the several species. The cross-section for the process ^{12}C + ^{65}Cu yields ^{12}B is found to be very much smaller than radioactivity measurements of ^{65}Zn from the same reaction, and hence ^{12}B and ^{65}Zn are probably not correlated fragments in a two-body break-up. (auth)

7802 (LBL—4000, pp 35-39) **Interpretations of line structure in delayed-neutron spectra.** Shihab-Eldin, A.A. (Univ. of California, Berkeley); Nuh, F.M.; Prussin, S.G.; Franz, H.; Kratz, J.V.; Kratz, K.L.; Rudolph, W.; Herrmann, G. Jul 1975.

In Nuclear chemistry. Annual report, 1974.

ENERGY LEVELS AND TRANSITIONS

7803 **Decoupled bands in medium mass nuclei.** von Brentano, P. (Univ., Cologne); Heits, B.; Protop, C. pp 154-165 of In Problems of vibrational nuclei. Alaga, G. (ed.). Amsterdam; North-Holland Publishing Co. (1975).

From Conference on vibrational nuclei; Zagreb, Yugoslavia (23 Sep 1974).

See CONF-740992—.

Experimental verification of the existence of Coriolis decoupled (stretched) bands in medium weight nuclei is discussed using examples from (α,xnγ) and (^{16}O, ^{18}O, xnγ) reactions and in-beam gamma spectroscopy. These measurements usually allow spin assignments for high spin states with a large degree of confidence. It is seen that the number of stretched high spin bands in medium mass transitional nuclei correlates well with the ground band in even neighboring nuclei. This parallelism seems to be a rather general phenomenon for high spin states in transitional nuclei. 2 tables, 11 figures. (SDF)

7804 **Nuclear Data Sheets for A = 183.** Artna-Cohen, A. (Oak Ridge National Lab., TN). *Nucl. Data Sheets;* **16**: No. 2, 267-316(Oct 1975).

The available experimental data pertaining to the nuclei with A = 183 are compiled. The data from various decay and reaction experiments have been evaluated, compared, and combined to

present an adopted level scheme for each nucleus. Arguments for spin, parity, and Nilsson level assignments are given. In addition, there are comments about the adopted level schemes and about discrepancies and deficiencies in the existing information. (auth)

NUCLEAR REACTIONS AND SCATTERING

7805 (ANL—75-75, pp 64-66) **Anomalies in the $^{72}Ge(\alpha,n)^{75}Se$ reaction near isobaric analog resonances in ^{76}Se.** Elwyn, A.J.; Monahan, J.E.; Lemming, J.F.; Rapaport, J.; Sample, M. 1975.

In Physics Division annual review, 1 April 1974—31 March 1975.

7806 (BNL—20680) **Absolute measurement of the critical scattering cross section in cobalt.** Glinka, C.J.; Minkiewicz, V.J.; Passell, L. (Brookhaven National Lab., Upton, N.Y. (USA)). 1975. 9p. (CONF-751209—18). Dep. NTIS $4.50.

From 21. annual conference on magnetism and magnetic materials; Philadelphia, Pennsylvania, USA (9 Dec 1975).

Small-angle neutron scattering techniques have been used to study the angular distribution of the critical scattering from cobalt above T/sub c/. These measurements have been put on an absolute scale by calibrating the critical scattering directly against the nuclear incoherent scattering from cobalt. In this way the interaction range r_1, which appears in the classical and modified Ornstein—Zernike expressions for the asymptotic form of the spin pair correlation function and is related to the strength of the spin correlations, has been determined. We obtain $r_1/a = 0.46 +- 0.03$ for the ratio of the interaction range to the nearest-neighbor distance in cobalt. This result is in good agreement with theoretical predictions. Lack of agreement among previous determinations of the ratio r_1/a made in iron failed to provide a definitive comparison with theory. (auth)

7807 (LBL—4000, pp 103) **Particles emitted in the interaction of Cu with ^{20}Ne at 252-MeV bombarding energy.** Jared, R.; Moretto, L.G.; Babinet, R.; Galin, J.; Hunter, J.; Schmitt, R.; Moulton, J.; Thompson, S.G. Jul 1975.

In Nuclear chemistry. Annual report, 1974.

7808 **Absolute cross sections for the $^{63,65}Cu(^{16}O,X)$ reactions.** Wells, J.C. Jr.; Robinson, R.L.; Kim, H.J.; Ford, J.L.C. Jr. (Tennessee Technological University, Cookeville, Tennessee 38501). *Phys. Rev., C*; **12**: No. 5, 1529-1539(Nov 1975).

The absolute cross sections for a number of different reactions resulting from the bombardment of $^{63,65}Cu$ with 38.5-, 41.0-, 43.5-, 46.0-, 48.5-, and 51.0-MeV ^{16}O ions were determined from γ-ray yields observed from the decay of resulting radioactivities, and from yields of in-beam γ rays. The total cross section was compared to an optical model calculation and to a parabolic barrier potential calculation. The relative population of the reaction products was compared to calculations for the statistical decay of a compound nucleus by n, p, and α evaporation. This model does account for the general features of the experimental results, and agrees reasonably well with the stronger exit channels. A summary of the general features of the $^{58,60,61}Ni(^{16}O, X)$ and $^{63,65}Cu(^{16}O, X)$ reactions is included. (AIP)

NUCLEAR PROPERTIES AND REACTIONS, A=90-149, THEORETICAL

NUCLEAR REACTIONS AND SCATTERING

7809 **Pion production in nucleus—nucleus collisions.** Schroeder, L.S. (Univ. of California, Berkeley). *AIP (Am. Inst. Phys.) Conf. Proc.*; No. 26, 642-652(1975).

From 6. international conference on high energy physics and nuclear structure; Santa Fe, New Mexico, USA (9 Jun 1975).

See CONF-750631—.

Current work on pion production in high energy nucleus-nucleus collisions is reviewed. The majority of existing data are of the inclusive variety in which a single final state pion is detected. Experimental data are compared and their possible contributions to obtaining new information on nuclear structure is discussed. Various models which attempt to explain the observed single-inclusive-pion spectra either on the basis of a nucleon-nucleus interaction in which Fermi motion is included or on some type of cooperative model are examined. Other areas of interest involving pion production include tests of charge symmetry and pion multiplicities. (auth)

NUCLEAR PROPERTIES AND REACTIONS, A=90-149, EXPERIMENTAL

ENERGY LEVELS AND TRANSITIONS

7810 **Experimental studies of vibration-like nuclei through their electromagnetic properties.** Meyer, R.A. (Univ. of California, Livermore). pp 128-154 of In Problems of vibrational nuclei. Alaga, G. (ed.). Amsterdam; North-Holland Publishing Co. (1975).

From Conference on vibrational nuclei; Zagreb, Yugoslavia (23 Sep 1974).

See CONF-740992—.

The influence of multiparticle effects on vibration-like nuclei is studied for odd mass nuclei in the region of Z = 50 and N less than 82. A brief description of experimental techniques is followed by a look at how the inclusion of three quasi particle effects can provide a model consistent with these results. Included are two-particle, one-hole states in odd Sb nuclei, three-particle clustering in the I nuclei, and one-proton, two-neutron configurations near N = 82. The effect of the Coriolis force on rotational structure in La and In is then considered along with a discussion of apparent deviation from vibrational character in N = 81 nuclei. Finally, systematics of higher order electromagnetic processes in the Sn region are mentioned. 10 figures, 115 references. (SDF)

7811 **New aspect of the quasi-γ band.** Sakai, M. (Univ., Tokyo). pp 181-198 of In Problems of vibrational nuclei. Alaga, G. (ed.). Amsterdam; North-Holland Publishing Co. (1975).

From Conference on vibrational nuclei; Zagreb, Yugoslavia (23 Sep 1974).

See CONF-740992—.

Experimental results for the $^{127}I(p,2n)^{126}Xe$ and $^{127}I(p,4n)^{124}Xe$ reactions are presented. The nuclear properties previously known and recently discovered quasi-γ bands are examined for consistency within the quasi band picture. B(E2) ratios for inter-band transitions are discussed and the energy spacing of the quasi-γ band is compared with that of the quasi-ground band. Consideration is given to the relationship between phonon and rotational levels. 11 figures, 4 tables. (SDF)

7812 **Experimental study of the pairing mode of elementary excitations.** Flynn, E.R. (Los Alamos Scientific Lab., NM). pp 423-443 of In Problems of vibrational nuclei. Alaga, G. (ed.). Amsterdam; North-Holland Publishing Co. (1975).

From Conference on vibrational nuclei; Zagreb, Yugoslavia (23 Sep 1974).

See CONF-740992—.

It is shown that the assumption of the pairing excitation as a true nuclear mode is verified experimentally. This is done first by showing results on the characteristics of the pairing excitation itself in several nuclear regions, and then considering the coupling of this excitation to the single particle mode. The excitations are considered first in the lead region where the experimental data cover a range of nuclei with up to three phonons present, a result not seen in the data available on the surface vibrational phonons. The N = 50 region is then considered and it is seen that the pairing phonon characteristics are remarkably consistent over a range of elements and that this consistency permits the assignment of parentage to states not otherwise amenable to calculations. The coupling of this pairing mode to single particle states is then considered with ^{209}Pb presented as an example with comparisons to theoretical results. Additional results in the N = 50 region also indicate an extension of these concepts to further assign nuclear spectroscopic information difficult by other methods. The collectivity of these phonons is clearly established. Finally, a brief treatment of the effect on the pairing excitations in the transition region is discussed. The emphasis here is on the rather little explored transition region near A = 100 to indicate the usefulness of the systematic properties of the pairing mode in the study of such transition regions. 9 figures. (auth)

7813 **Energy levels in ^{144}Nd.** Raman, S. (Oak Ridge National Lab., TN); Slaughter, G.G.; Harvey, J.A.; Jurney, E.T.; McClure, D.A.; Wells, J.C. Jr.; Lin, J. pp 562-564 of In Neutron capture gamma-ray spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2. international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974).

See CONF-740920—.

An energy level scheme for ^{144}Nd is constructed with 58 excited states below 3.5 MeV. This scheme is based mainly on singles (n,γ) measurements with both thermal and resonance neutrons and on Ge(Li)—Ge(Li) coincidence measurements following thermal capture. The energy levels in ^{144}Nd populated in the $^{143}Nd(n,\gamma)$ reaction with thermal and resonance neutrons are

investigated. The spin and parity of the ^{143}Nd ground state are $^{7}/_{2}^{-}$. The capture of s-wave neutrons, therefore, leads to 3^{-} or 4^{-} capturing states. (auth)

7814 **g-factor of the 6^{+} state of ^{90}Nb.** Holland, R.E.; Lynch, F.J. (Argonne National Lab., Ill. (USA)); Mitchell, R.J.; Ragland, T.V.; Scharenberg, R.P. *Phys. Lett., B;* **58**: No. 1, 43-45(18 Aug 1975).

The g-factor of the 88 μs isomeric 6^{+} state of ^{90}Nb has been measured by the time-differential perturbed-angular distribution method. The observed g-factor of 0.620 +- 0.004 agrees within the error with a recent measurement of the 8^{+} ground state of ^{90}Nb and verifies additivity to this accuracy in ^{90}Nb. (NL)

7815 **Nuclear Data Sheets for A = 115.** Raman, S.; Kim, H.J. (Oak Ridge National Lab., TN). *Nucl. Data Sheets;* **16**: No. 2, 195-230(Oct 1975).

The 1960 version of Nuclear Data Sheets for A = 115 has been revised on the basis of experimental data received before July 1974, with some modifications received via private communications. Experimental data concerning the nuclear structure of isotopes were compiled and used in the construction of the level schemes and in the deduction of numerous level properties and J/sup pi/-assignments. (auth)

7816 **Nuclear Data Sheets for A = 144.** Burrows, T.W. (Univ. of Kentucky, Lexington); Auble, R.L. *Nucl. Data Sheets;* **16**: No. 2, 231-266(Oct 1975).

The 1967 version of Nuclear Data Sheets for A = 144 has been revised on the basis of experimental data received by February 7, 1975. Experimental data quoted in the 1967 version which have been largely superseded by more recent work have been omitted from the present revision. Data for which there have been no new measurements have only been summarized in the present revision. (auth)

MOMENTS AND SPIN

7817 (ANL—75-75, pp 68, 69) **Measurement of the g factor of the 6^{+}, 88-μsec isomeric state of ^{90}Nb.** Mitchell, R.J.; Ragland, T.V.; Scharenberg, R.P.; Holland, R.E.; Lynch, F.J. 1975.

In Physics Division annual review, 1 April 1974—31 March 1975.

7818 (ANL—75-75, pp 74, 76, 77) **Measurement of the g factor of the 10-μsec isomeric state of ^{115}Te.** Mitchell, R.J.; Ragland, T.V.; Scharenberg, R.P.; Lynch, F.J.; Holland, R.E. 1975.

In Physics Division annual review, 1 April 1974—31 March 1975.

NUCLEAR REACTIONS AND SCATTERING

7819 (ANL—75-75, pp 37, 38) **^{16}O and ^{18}O induced reactions on ^{118}Sn at the Coulomb barrier.** Eisen, Y.; Henning, W.; Koerner, H.J.; Kovar, D.G.; Schiffer, J.P.; Vigdor, S.E.; Zeidman, B. 1975.

In Physics Division annual review, 1 April 1974—31 March 1975.

7820 (LBL—4000, pp 70-71) **Study of the ^{142}Nd(^{18}O, ^{16}O) ^{144}Nd reaction.** Yagi, K. (Osaka Univ.); Harvey, B.; Hendrie, D.; Jahnke, U.; Maguire, C.; Mahoney, J.; Scott, D. Jul 1975.

In Nuclear chemistry. Annual report, 1974.

7821 (LBL—4000, pp 74-76) **Interference between direct and indirect modes in two-nucleon transfer reactions with heavy ions.** Harvey, B.G. (Hahn—Meitner Institut, Berlin); Hendrie, D.L.; Jahnke, U.; Kraus, L.; Maguire, C.F.; Mahoney, J.; Scott, D.K.; Terrien, Y.; Yagi, K.; Glendenning, N.K. Jul 1975.

In Nuclear chemistry. Annual report, 1974.

7822 (LBL—4000, pp 104-106) **Study of the relaxation processes in the reaction between ^{107} ^{109}Ag and ^{20}Ne at 175 MeV and 252 MeV.** Babinet, R.; Galin, J.; Fowler, M.; Jared, R.; Hunter, J.; Moretto, L.G.; Thompson, S.G. Jul 1975.

In Nuclear chemistry. Annual report, 1974.

7823 (LBL—4000, pp 106-107) **Study of the fragments emitted in the interaction between Ag and ^{40}Ar at 288-MeV and 340-MeV bombarding energy.** Galin, J.; Babinet, R.; Fowler, M.; Jared, R.; Gatti, R.; Thompson, S.G.; Moretto, L.G. Jul 1975.

In Nuclear chemistry. Annual report, 1974.

7824 (ORNL-TM—5097) **Mo(n,xγ) reaction cross section for incident neutron energies between 0.2 and 20.0 MeV.** Morgan, G.L.; Newman, E. (Oak Ridge National Lab., Tenn. (USA)). Dec 1975. Contract W-7405-eng-26. 54p. (ENDF—220). Dep. NTIS $5.50.

Differential cross sections for the neutron-induced gamma-ray production from natural molybdenum have been measured for incident neutron energies between 0.2 and 20.0 MeV. The Oak Ridge Linear Accelerator (ORELA) was used to provide the neutrons and a NaI spectrometer to detect the gamma rays at 125°. The data presented are the double differential cross section, d²sigma/dΩ for coarse intervals in incident neutron energy. The integrated yield of gamma rays of energies greater than 300 keV and higher resolution in the neutron energy is also presented. The experimental results are compared with the Evaluated Neutron Data Files (ENDF). 24 figures, data tables. (auth)

7825 **Gamma-rays from neutron capture in and between resonances.** Chrien, R.E. (Brookhaven National Lab., Upton, NY). pp 247-270 of In Neutron capture gamma-ray spectoscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2. international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974).

See CONF-740920—.

Experiments on neutron capture γ-ray emission in and between resonances, and the extent of their conformity to, or departure from, purely statistical assumptions are examined. Resonance capture with subsequent radiative transitions to discrete final states can be a powerful tool in nuclear spectroscopy, with the non-specific character of the (n,γ) reaction leading to populating states of differing nuclear structure. Capture between resonances, however, is expected to be influenced by direct components. Capture γ-ray spectra obtained in the off-resonance region can be fitted with interfering resonance and background amplitude terms, and the direct component extracted. Near neutron strength function peaks, especially near the 3s and 3p maxima, width correlations are clearly seen in resonance and resonance-averaged spectra. Valence transitions are shown to be inadequate to describe these correlations. (auth)

7826 **Energy levels in the odd-N Sm isotopes.** Smither, R.K. (Argonne National Lab., IL). pp 358-363 of In Neutron capture gamma-ray spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2. international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974).

See CONF-740920—.

Four different types of neutron capture gamma-ray experiments are used to investigate the energy level structure of the odd-N Sm isotopes. The gamma ray branching ratios for the low-lying levels are used to help follow the level structure from the well-deformed ^{155}Sm and ^{153}Sm nuclei, through the transitions, ^{151}Sm, ^{149}Sm and ^{147}Sm nuclei, to the near-spherical ^{145}Sm nucleus. (auth)

7827 **Average p-wave resonance capture spectra from isotopes of molybdenum.** Rimawi, K.; Chrien, R.E. (Brookhaven National Lab., Upton, NY). pp 364-367 of In Neutron capture gamma-ray spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2. international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974).

See CONF-740920—.

A 24 keV Fe-filtered beam has been used to study p-wave capture on even Mo targets. The capture γ-ray spectra show pronounced correlations with final state spectroscopic factors. The valence model is only of limited success in accounting for these correlations. (auth)

7828 **Neutron capture in Nb at E/sub n/ = 24 keV.** Rimawi, K.; Chrien, R.E. (Brookhaven National Lab., Upton, NY). pp 368-370 of In Neutron capture gamma-ray spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2. international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974).

See CONF-740920—.

Gamma-rays resulting from 24 keV neutron capture on niobium are observed to confirm previously reported correlations from resonance capture at lower energies. The correlation coefficient with (d,p) stripping widths is about 0.5. (auth)

7829 **Thermal neutron capture on ^{142}Ce.** Gelletly, W. (Univ. of Manchester, Eng.); Kane, W.R.; Casten, R.F. pp 526-531 of In Neutron capture gamma-ray spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2. international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974).

See CONF-740920—.

The gamma-rays from thermal neutron capture on ^{142}Ce have been studied in singles and coincidence with Ge(Li) detectors. A level scheme for ^{143}Ce has been established. The intensities of the primary gamma-rays to levels below 2 MeV appear to be correlated with the strengths of excitation of the levels in the (d,p) reaction, which suggests that direct capture is important in this reaction. (auth)

7830 Direct-reaction cross sections in collisions between heavy ions. Henning, W.; Schiffer, J.P.; Kovar, D.G.; Vigdor, S.; Zeidman, B.; Eisen, Y.; Koerner, H.J. (Argonne National Lab., Ill. (USA)). *Phys. Lett., B;* **58**: No. 2, 129-131(1 Sep 1975).

Cross sections for all transfer channels, as well as inelastic and elastic scattering have been measured near the Coulomb barrier for ^{18}O + ^{118}Sn and well above the barrier for ^{16}O + ^{48}Ca. The total direct cross sections are decomposed into partial wave contributions, the largest of which are found to be of the same order of magnitude as elastic scattering. The implications of these results for the mechanism of heavy—ion direct reactions is discussed. (NL)

7831 Back-angle elastic alpha scattering from ^{89}Y and $^{90\ 91\ 94}$Zr. Wit, M.; Schiele, J.; Eberhard, K.A.; Schiffer, J.P. (Sektion Physik, Universitat Muenchen, D-8046 Garching, Germany). *Phys. Rev., C;* **12**: No. 5, 1447-1451(Nov 1975).

Excitation functions and angular distributions for elastic α scattering from target nuclei around A = 90 have been measured in an effort to obtain a precise picture of the cross sections at backward angles. Excitation functions between E/sub alpha/(lab) = 18 through 25 MeV for α + ^{89}Y and α + $^{90\ 91\ 94}$Zr have been measured in steps of 500 keV or less at angles between 141° and 176° (lab). Near 180°, narrow (about 1 MeV minima, with a drop in cross section by more than an order of magnitude, are observed around E/sub alpha/ = 23 MeV for the α + ^{89}Y and α + $^{90\ 91}$Zr elastic scattering. A similar, but less pronounced, structure is seen in the excitation function for α + ^{94}Zr. Angular distributions between 48.5° and 176° (lab) measured at several energies in 2.5° steps show a regular, diffractionlike pattern over the entire angular range. A standard four-parameter Woods-Saxon potential is found to be sufficient to provide a detailed fit to the experimental data including the minima in the excitation functions at back angles. (AIP)

7832 Neutron-capture gamma rays from ^{116}Sn and ^{122}Sn and the valence model. Bhat, M.R.; Chrien, R.E.; Cole, G.W.; Wasson, O.A. (Brookhaven National Laboratory, Upton, New York 11973). *Phys. Rev., C;* **12**: No. 5, 1457-1461(Nov 1975).

Capture γ-ray intensities from resonances of ^{116}Sn and ^{122}Sn have been measured. The results lead to binding energies of 6944 +- 2.0 keV for the product nucleus ^{117}Sn and 5948 +- 3.0 keV for the product nucleus ^{123}Sn. Resonance spins were determined: in ^{116}Sn, E_0 = 147.9 and E_0 = 632 eV resonances are J = 3/2, l=1; ^{122}Sn, E_0 = 106.9 eV resonance is J = 3/2, l = 1; E_0 = 259.9 eV resonance is J = 1/2, l = 1. The measured partial widths are compared to single-particle transition model predictions. The model fails to predict the observed widths. (AIP)

7833 Spin-dependent potentials for deuteron-nucleus scattering. Knutson, L.D.; Haeberli, W. (University of Wisconsin, Madison, Wisconsin 53706). *Phys. Rev., C;* **12**: No. 5, 1469-1477(Nov 1975).

Measurements of the cross section, the vector analyzing power, and the three tensor analyzing powers for deuteron elastic scattering from ^{90}Zr at 5.5 MeV and from ^{208}Pb at 9.0 MeV are presented. These measurements and additional measurements obtained from the literature are analyzed in terms of the optical model. The folding model is used to calculate the spin-dependent potentials from the known nucleon-nucleus potentials, and the central terms in the optical potential are determined empirically. Acceptable agreement is obtained for the cross section and vector analyzing power. The calculations reproduce the observed tensor analyzing powers for sub-Coulomb energies but not for energies above the Coulomb barrier. (AIP)

NUCLEAR PROPERTIES AND REACTIONS, A=150-189, EXPERIMENTAL

MASS, ABUNDANCE, AND BINDING ENERGY

7834 Deformation parameters of the charge distribution and the optical potential for some nuclei in and near the rare earth region. Lee, I.Y.; Saladin, J.X.; Holden, J.; O'Brien, J.; Baktash, C.; Bemis, C. Jr.; Stelson, P.H.; McGowan, F.K.; Milner, W.T.; Ford, J.L.C. Jr.; Robinson, R.L.; Tuttle, W. (University of Pittsburgh, Pittsburgh, Pennsylvania 15260). *Phys. Rev., C;* **12**: No. 5, 1483-1494(Nov 1975).

Elastic and inelastic scattering of α particles on ^{154}Sm, ^{166}Er, ^{168}Er, ^{182}W, ^{184}W, and ^{186}W was performed with incident energies between 11 and 21 MeV. Excitation functions for 0$^+$, 2$^+$, and 4$^+$ states of the ground state rotational band were measured. Pronounced destructive nuclear-Coulomb interference effects were observed. Reduced E2 and E4 transition moments and charge and optical potential deformation parameters were determined from coupled channel analysis of both the sub-Coulomb and interference data. (AIP)

ENERGY LEVELS AND TRANSITIONS

7835 (ANL—75-75, pp 143-144) **Nuclear structure of ^{148}Sm, ^{150}Sm, and ^{152}Sm.** Smither, R.K.; Bushnell, D.L. 1975.

In Physics Division annual review, 1 April 1974—31 March 1975.

7836 (LBL—4000, pp 16-17) **Levels of ^{156}Dy and decay scheme of ^{156}Ho isomers.** Iwata, S. (Kyoto Univ., Kumatori, JA); Tamura, T.; Rasmussen, J.O.; Needham, R. Jul 1975.

In Nuclear chemistry. Annual report, 1974.

7837 (LBL—4000, pp 276-278) **Nuclear orientation measurement of parity admixture in the 501-keV gamma transition in ^{180}Hf/sup m/.** Chou, T.S.; Krane, K.S.; Shirley, D.A. Jul 1975.

In Nuclear chemistry. Annual report, 1974.

7838 Transitional nucleus ^{152}Eu. Cooperation Munich—Livermore—Risoe—Tallahassee—Los Alamos—Riga—Juelich—Brookhaven. pp 532-536 of In Neutron capture gamma-ray spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2. international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974).

See CONF-740920—.

A level scheme of ^{152}Eu is proposed based on (n,e), (n,γ), (n,$\gamma\gamma$), (n/sub res/,γ), (d,t), (d,p) and (p,d) experiments. Spin and parity assignments are given to many levels. The lifetimes of two levels were measured. The energy of the 0$^-$ isomeric state is 45.63 +- 0.02 keV. (auth)

7839 Capture gamma-ray research at Lawrence Livermore Laboratory. Mann, L.G.; Lanier, R.G.; Larsen, J.T.; Richards, W.J. (Univ. of California, Livermore). pp 578-583 of In Neutron capture gamma-ray spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2. international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974).

See CONF-740920—.

A filtered external neutron beam from the Livermore pool-type reactor is used for capture γ-ray research. Two Ge(Li) detectors are used either singly or in coincidence. One detector can be operated in the Compton suppression mode and the other in the pair spectrometer mode. In coincidence work three parameters (E/sub gamma/, E/sub gamma/, t) are stored and analyzed. A bent crystal spectrometer of the Cauchois type has recently become operational for use with sources in the reactor through a tube. Recent data on ^{181}Ta and ^{160}Tb are presented. 6 figures. (auth)

7840 Decays of 2.45-h ^{179}Ta/sup m/ and 23.8-min ^{178}Lu/sup m/ to the K/sup π/ = 8$^-$ levels in ^{178}Hf. Ward, T.E.; Chu, Y.Y. (Chemistry Department, Brookhaven National Laboratory, Upton, New York 11973). *Phys. Rev., C;* **12**: No. 5, 1632-1637(Nov 1975).

The decays of the high-spin isomers of ^{179}Ta (2.45 h) and ^{178}Lu (23.8 min) to the two strongly admixed K/sup π/ = 8$^-$ states in ^{178}Hf were reinvestigated. The main features of the previously reported decay schemes are confirmed and several long-standing ambiguities are resolved. The results of this investigation indicate that the 1147-keV level is largely the two-neutron state and the 1479-keV level is largely the two-proton state in ^{178}Hf. They are found to be 34% admixed with one another. This mixing value is in good agreement with the value deduced from the M1/E2 cascade ratios of the 1147-keV band and from the comparison of the E1 (ν = 7) hindrance factors of these two states in this mass region. The band-mixing matrix element for these two states was found to be in agreement with the recent theory which introduces the residual neutron-proton interaction to account for the mixing. The spin-parity of ^{178}Lu/sup m/ (23.8 min) was deduced to be K/sup π/ = 9$^-$ with a possible Nilsson configuration of 9/2$^-$ [514] /subp/, 9/2$^+$ [624] /subn/. (AIP)

NUCLEAR REACTIONS AND SCATTERING

7841 (LBL—4000, pp 47-49) **Excitation functions of compound nucleus products from the reaction $^{40}Ar + {}^{175}Lu$.** Alonso, J.R.; Alonso, C.T.; Ghiorso, A.; Nitschke, J.M.; Nurmia, M. Jul 1975.

In Nuclear chemistry. Annual report, 1974.

7842 (LBL—4000, pp 73-74) **Opposite interference effects observed in the $^{148}Sm(^{18}O, {}^{16}O)^{150}Sm$ and the $^{150}Sm(^{16}O,{}^{18}O)^{148}Sm$ reactions.** Maguire, C.; Harvey, B.; Hendrie, D.; Homeyer, H.; Jahnke, U.; Mahoney, J.; Scott, D.; Glendenning, N.K. Jul 1975.

In Nuclear chemistry. Annual report, 1974.

7843 **Direct capture studies in the 4s giant resonance region.** Cole, G.W.; Chrien, R.E. (Brookhaven National Lab., Upton, NY). pp 271-276 of In Neutron capture gamma-ray spectoscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2. international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974).

See CONF-740920—.

Non-resonant radiative capture of epithermal neutrons has been investigated for five targets in the range A = 152 to 186. Significant direct reaction cross-sections are observed for final states of good single particle character. (auth)

7844 **Energy levels of ^{155}Gd and ^{157}Gd populated by the (n,γ) reaction using 24.5 keV neutrons.** Greenwood, R.C. (Aerojet Nuclear Co., Idaho Falls, ID); Reich, C.W.; Chrien, R.E.; Rimawi, K. pp 353-357 of In Neutron capture gamma-ray spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2. international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974).

See CONF-740920—.

The properties of a 24-keV neutron beam, obtained from HFBR through an Fe + Al + S filter, which make it a useful tool in nuclear spectroscopy have been studied. As an application of these techniques, the prompt γ-rays from 24-keV neutron capture in ^{154}Gd and ^{156}Gd have been measured. (auth)

NUCLEAR PROPERTIES AND REACTIONS, A=190-219, THEORETICAL

ENERGY LEVELS AND TRANSITIONS

7845 (COO—3069-372) **Nuclear ground state.** Negele, J.W. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Physics). 1975. Contract AT(11-1)-3069. 31p. (CONF-750990—1). Dep. NTIS $5.00.

From Meeting on electron scattering at intermediate energy; Saclay, France (8 Sep 1975).

The nuclear ground state is surveyed theoretically, and specific suggestions are given on how to critically test the theory experimentally. Detailed results on ^{208}Pb are discussed, isolating several features of the charge density distributions. Analyses of ^{208}Pb electron scattering and muonic data are also considered. 14 figures. (SDF)

NUCLEAR PROPERTIES AND REACTIONS, A=190-219, EXPERIMENTAL

RADIOACTIVE DECAY

7846 (LBL—4000, pp 5-7) **Alpha decay studies of the high spin isomer of bismuth-210.** Tuggle, D.; Asaro, F.; Perlman, I. Jul 1975.

In Nuclear chemistry. Annual report, 1974.

7847 (LBL—4000, pp 7-9) **K-shell electron shake-off accompanying alpha decay.** Rapaport, M.S.; Asaro, F.; Perlman, I. Jul 1975.

In Nuclear chemistry. Annual report, 1974.

NUCLEAR REACTIONS AND SCATTERING

7848 (COO—2174-35) **Neutron resonance spectroscopy: ^{209}Bi.** Singh, U.N.; Rainwater, J.; Liout, H.I.; Hacken, G.; Garg, J.B. (Columbia Univ., New York (USA)). 1975. 3p. (CONF-750303—81). Dep. NTIS $4.50.

From Proceedings on nuclear cross section and technique; Washington, District of Columbia, USA (3 Mar 1975).

Neutron time-of-flight transmission measurements were made on several samples of ^{209}Bi by using the Nevis Synchrocyclotron of Columbia University. The resonance parameters are given for 29 levels to 75 keV. Out of the 29 observed levels 10 were l = 0 and 19 were l = 1 levels. The implied s and p strength functions are $10^4S_0 = (0.60^{+0.39}/\text{sub } -0.21/)$ and $10^4S_1 + (0.19^{+0\ 08}$ /sub -0.05/). 1 figure, 2 tables. (auth)

7849 (LBL—4000, pp 42-44) **Recoil range studies from reactions of ^{40}Ar with ^{209}Bi and ^{232}Th.** Otto, R.J.; Raunemaa, T.; Fowler, M.M.; Williams, K.; Seaborg, G.T. Jul 1975.

In Nuclear chemistry. Annual report, 1974.

7850 (LBL—4000, pp 97-99) **Argon-induced transfer reactions at Coulomb barrier energies.** Eggers, R.C. (Texas A and M Univ., College Station, TX); Rasmussen, J.O.; Ribbe, W.S. Jul 1975.

In Nuclear chemistry. Annual report, 1974.

7851 (LBL—4000, pp 111-112) **Study of fragments emitted in the interaction between ^{197}Au and ^{40}Ar at 288-MeV and 340-MeV bombarding energy.** Moretto, L.G.; Babinet, R.; Galin, J.; Schmitt, R.; Fraenkel, Z.;Jared, R.; Hunter, J.; Thompson, S.G. Jul 1975.

In Nuclear chemistry. Annual report, 1974.

7852 **Low-spin states in ^{202}Hg.** Breitig, D.; Casten, R.F.; Kane, W.R.; Cole, G.W.; Cizewski, J. (Brookhaven National Lab., Upton, NY). pp 316-322 of In Neutron capture gamma-ray spectoscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2. international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974).

See CONF-740920—.

States in ^{202}Hg have been studied with several techniques involving the (n,γ) reaction at thermal and resonant neutron energies. Gamma ray spectra were recorded for primary and secondary transitions and in singles and coincidence modes. A level scheme comprised of 22 excited states and approximately 80 transitions was constructed. Comparison of these results with analogous results for ^{200}Hg reveals important nuclear structure differences. (auth)

SPONTANEOUS AND INDUCED FISSION

7853 (LBL—4000, pp 114-115) **Fission excitation functions in medium-heavy nuclei.** Moretto, L.G.; Gatti, R.C.; Schmitt, R.P.; Thompson, S.G. Jul 1975.

In Nuclear chemistry. Annual report, 1974.

NUCLEAR PROPERTIES AND REACTIONS, A=220 AND ABOVE, THEORETICAL

7854 (TID—3317(Suppl.6)) **Transplutonium elements. A bibliography.** Stuber, C.E. (Energy Research and Development Administration, Oak Ridge, Tenn. (USA). Technical Information Center). Nov 1975. 242p. Dep. NTIS $7.60.

This bibliography, prepared especially for distribution at the IAEA/ERDA International Symposium on the Transuranium Nuclides in the Environment, San Francisco, November 17-21, 1975, comprises 589 references on the transplutonium elements compiled through the period January 1 to October 15, 1975. The references were retrieved from the Nuclear Science Abstracts (NSA) data base using a computerized information retrieval system and were formatted for publication with indexes by computer. Part I includes 565 references dealing with the production and chemical, nuclear, physical, and biological properties and health, safety, and environmental aspects of elements with Z greater than or equal to 95. Part II includes 24 references dealing with the natural occurrence of the transplutonium elements. This collection of references is concerned with attempts to locate or prove the existence of the transplutonium elements in nature. Part III, a feature added to enhance the usefulness of this bibliography to the participants at this symposium, contains 772 references on the environmental aspects of neptunium and plutonium retrieved from NSA through the period June 1, 1973 through October 15, 1975. Author, report number, and subject indexes are included. (auth)

NUCLEAR REACTIONS AND SCATTERING

7855 Effects of rotation on the stability of nuclei under fission and the possibility of fusion in heavy-ion reactions. Mustafa, M.G.; Kumar, K. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). *Phys. Rev., C;* **12**: No. 5, 1638-1646(Nov 1975).

The two-center shell model for fission is extended to include the effects of nuclear rotation or angular momentum J. The principle of minimization of total nuclear energy with respect to a constraint on J leads to an effective potential energy which depends on J as well as moment of inertia. This effective potential energy is minimized with respect to nuclear shape variables, neutron pairing energy gap, and proton pairing energy gap for each J value. The resulting potential minima, fission barriers, and moments of inertia are quite sensitive to J. Results are given for $^{208}_{82}$Pb, $^{240}_{94}$Pu, and for a super-heavy nucleus $^{298}_{114}$X. Our microscopic calculations of the critical angular momentum (at which the fission barrier vanishes) are compared with the rotating liquid drop calculations of Cohen, Plasil, and Swiatecki. The influence of these results on the possibility of fusion in heavy-ion reactions is discussed. (AIP)

SPONTANEOUS AND INDUCED FISSION

7856 (LBL—4000, pp 171-175) **Theoretical estimates of spontaneous-fission half-lives for superheavy elements.** Randrup, J. (Lund Institute of Technology, Sweden); Larson, S.E.; Moeller, P.; Sobiczewski, A.; Tukasiak, A. Jul 1975.

In Nuclear chemistry. Annual report, 1974.

NUCLEAR PROPERTIES AND REACTIONS, A=220 AND ABOVE, EXPERIMENTAL

RADIOACTIVE DECAY

7857 (LBL—4000, pp 50-53) **Element 106.** Ghiorso, A. (Univ. of California, Livermore); Hulet, E.K.; Nitschke, J.M.; Alonso, J.R.; Lougheed, R.W.; Alonso, C.T.; Nurmia, M.; Seaborg, G.T. Jul 1975.

In Nuclear chemistry. Annual report, 1974.

7858 (LBL—4000, pp 278-280) **Nuclear orientation studies of ^{241}Am and ^{255}Fm.** Soinski, A.J.; Shirley, D.A. Jul 1975.

In Nuclear chemistry. Annual report, 1974.

ENERGY LEVELS AND TRANSITIONS

7859 (ANL/NDM—16) **Fast neutron excitation of the ground-state rotational band of ^{238}U.** Guenther, P.; Havel, D.; Smith, A. (Argonne National Lab., Ill. (USA)). Sep 1975. 55p. Dep. NTIS $5.50.

The differential neutron cross sections for the excitation of the 2+(45 keV), 4+(148 keV) and 6+(308 keV) states of ^{238}U are measured for scattered neutron energies in the range 0.1 to 3.0 MeV. The observed excitation cross sections vary smoothly with energy with no significant fluctuations. The experimental results are correlated with the predictions of compound-nucleus and direct-reaction models. At lower energies (less than or approximately equal to 0.8 MeV) the observed inelastic scattering cross sections are consistent in shape and magnitude with the predictions of compound-nucleus theory. Above approximately or equal to 1.0 MeV comparison of measured and calculated values indicates large direct-reaction contributions. The experimental and computational results are compared with the evaluated nuclear data file, ENDF/B-IV, and significant discrepancies are noted. The present results and selected values from the literature are used to deduce an evaluated set of ^{238}U inelastic scattering cross sections. 11 figures, 4 tables. (auth)

NUCLEAR REACTIONS AND SCATTERING

7860 (LBL—4000, pp 44-46) **Radiochemical mass yield distribution studies in the reaction of ^{40}Ar with ^{238}U and ^{209}Bi and 25.2 GeV ^{12}C with ^{238}U.** Otto, R.J.; Fowler, M.M.; Lee, D.; Binder, I.; Seaborg, G.T. Jul 1975.

In Nuclear chemistry. Annual report, 1974.

7861 (LBL—4000, pp 115-116) **Complete fusion cross sections for the ^{20}Ne + ^{235}U system.** Viola, V.E. Jr. (Univ. of Maryland, College Park); Zebelman, A.M.; Sextro, R.G.; Meyer, W.G.; Clark, R.G. Jul 1975.

In Nuclear chemistry. Annual report, 1974.

7862 (NEANDC(E)—163U, pp 203-217) **Recent measurements on ^{238}U at ORNL.** de Saussure, G. (Oak Ridge National Lab., TN). Jan 1975.

From Specialists meeting on resonance parameters of fertile nuclei ^{a}232Th, 238U, 240Pu^{a} and of 239Pu; Saclay, France (20 May 1974).

In Specialists meeting on resonance parameters of fertile nuclei and ^{239}Pu.

SPONTANEOUS AND INDUCED FISSION

7863 (UCID—16981) **Fission cross section ratio of ^{239}Pu to ^{235}U from 0.1 to 30 MeV.** Carlson, G.W.; Behrens, J.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Dec 1975. Contract W-7405-Eng-48. 9p. Dep. NTIS $4.50.

Results are given for the neutron-induced fission cross section ratio of ^{239}Pu to ^{235}U in the neutron energy range 0.1 to 30 MeV. These data were normalized with an estimated total uncertainty of +-2 percent using the threshold cross section method. Work still in progress includes a normalization at thermal neutron energy. A more detailed discussion of our measurements will be presented upon completion of this work. A table of the present cross section ratio data is included. (auth)

7864 Distribution of mass in thermal-neutron-induced fission of ^{257}Fm. Flynn, K.F.; Gindler, J.E.; Glendenin, L.E. (Chemistry Division, Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev., C;* **12**: No. 5, 1478-1482(Nov 1975).

Fission yields were measured radiochemically for mass chains 112, 127, 132, and 140 in thermal-neutron-induced fission of ^{257}Fm. These yields indicate a single-peaked (symmetric) mass distribution. Comparison is made with the distribution deduced from kinetic-energy measurements, and the effects of neutron emission from the fission fragments are considered. (AIP)

NUCLEAR THEORY

NUCLEAR STRUCTURE

7865 (LBL—4000, pp 179-183) **Thermodynamical properties of a paired nucleus with a fixed number of quasi-particles.** Moretto, L.G. Jul 1975.

In Nuclear chemistry. Annual report, 1974.

7866 (ORNL-TM—5174) **Inversion of single-particle levels in nuclear Hartree-Fock and Brueckner-HF calculations with broken symmetry.** Becker, R.L.; Svenne, J.P. (Oak Ridge National Lab., Tenn. (USA)). Dec 1975. Contract W-7405-eng-26. 49p. Dep. NTIS $5.45.

Energy levels of states connected by a symmetry of the Hamiltonian normally should be degenerate. In self-consistent field theories, when only one of a pair of single-particle levels connected by a symmetry of the full Hamiltonian is occupied, the degeneracy is split and the unoccupied level often lies below the occupied one. Inversions of neutron-proton (charge) and time-reversal doublets in odd nuclei, charge doublets in even nuclei with a neutron excess, and spin-orbit doublets in spherical configurations with spin-unsaturated shells are examined. The origin of the level inversion is investigated, and the following explanation offered. Unoccupied single-particle levels, from a calculation in an A-particle system, should be interpreted as levels of the (A + 1)-particle system. When the symmetry-related level, occupied in the A-particle system, is also calculated in the (A + 1)-particle system it is degenerate with or lies lower than the other. That is, when both levels are calculated in the (A + 1)-particle system, they are not inverted. It is demonstrated that the usual prescription to occupy the lowest-lying orbitals should be modified to refer to the single-particle energies calculated in the (A + 1)- or the (A - 1)-particle system. This observation is shown to provide a justification for avoiding an oscillation of occupancy between symmetry-related partners in successive iterations leading to a self-consistency. It is pointed out that two degenerate determinants arise from occupying one or the other partner of an initially degenerate pair of levels and then iterating to self-consistency. The existence of the degenerate determinants indicates the need for introducing correlations, either by mixing the two configurations or by allowing additional symmetry-breaking (resulting in a more highly deformed non-degenerate configuration). 2 figures, 3 tables, 43 references. (auth)

7867 (RLO—1388-294) **Charge dependent mixing.** Adelberger, E.G. (Washington Univ., Seattle (USA). Nuclear Physics Lab.). 1975. 21p. (CONF-7409138—1). Dep. NTIS $4.50.

From Conference on nuclear physics; Amsterdam, Netherlands (Sep 1974).

A few issues relating to charge dependent (CD) mixing in light nuclei are discussed, emphasizing recent progress and attempting to provide a critical assessment of what has been learned. The main topics include the effect of CD distortion on β, γ, and particle reaction rates involving low lying states, isospin mixing in ^{8}Be and ^{12}C, and isospin mixing in T = $^{3}/_{2}$ states. 14 figures. (SDF)

7868 EFFECTIVE INTERACTIONS AND OPERATORS IN NUCLEI. VOLUME II. PROCEEDINGS OF THE TUCSON INTERNATIONAL TOPICAL CONFERENCE ON NUCLEAR PHYSICS, TUCSON, ARIZONA, JUNE 2—6, 1975. Barrett, B.R. (ed.). Lecture Notes in Physics, Volume 40. New York; United States of America (USA); Springer-Verlag (1975). 350p. (CONF-750663—P2).

From International topical conference on effective interactions and operators in nuclei; Tucson, Arizona, USA (2 Jun 1975).

Separate abstracts are prepared for 13 papers appearing in NSA, three of which also appear in ERDA Energy Research Abstracts. (SPF)

7869 Relevant aspects of statistical spectroscopy. French, J.B. (Univ. of Rochester, NY). pp 191-206 of In Effective interactions and operators in nuclei. Volume II. Barrett, B.R. (ed.). New York; Springer-Verlag (1975).

From International topical conference on effective interactions and operators in nuclei; Tucson, Arizona, USA (2 Jun 1975).

See CONF-750663—P2.

Three aspects of statistical spectroscopy are studied: (1) information obtainable from complex spectra, (2) procedures for spectroscopy in huge model spaces, and (3) ways of identifying and calculating measurable parameters of the effective Hamiltonian and other operators, and of comparing different Hamiltonians. 4 figures. (SDF)

7870 Density dependent interactions. Negele, J.W. (Massachusetts Inst. of Tech., Cambridge). pp 270-295 of In Effective interactions and operators in nuclei. Volume II. Barrett, B.R. (ed.). New York; Springer-Verlag (1975).

From International topical conference on effective interactions and operators in nuclei; Tucson, Arizona, USA (2 Jun 1975).

See CONF-750663—P2.

Density dependent interactions have been treated on two different levels. The most fundamental level deals with G(W) and involves a systematic expansion of the density matrix about the center of mass of the two interacting particles. It has been shown that only the local behavior of the density matrix is essential. Thus a systematic expansion for G(W) is obtained such that the first term depends only on the local density and the next term involves the local kinetic energy density. These ideas generalize straightforwardly to approximating the three-body Faddeev equations in finite nuclei, and offer the most computationally practical scheme for use in heavy nuclei. The second level of approximation is to obtain an approximate Hamiltonian density which offers the computational simplicity of Skyrme-like forces. Although such a reduction offers tremendous technical simplification in calculations, it suffers from a serious lack of generality. Thus, it is not in fact valid for many of the applications for which the Skyrme force is presently being used and serious effort should be devoted to generalizing it for each of these applications. 7 figures. (auth)

7871 Calculation of other effective operators. Ellis, P.J. (Univ. of Minnesota, Minneapolis). pp 296-312 of In Effective interactions and operators in nuclei. Volume II. Barrett, B.R. (ed.). New York; Springer-Verlag (1975).

From International topical conference on effective interactions and operators in nuclei; Tucson, Arizona, USA (2 Jun 1975).

See CONF-750663—P2.

A great deal has been written about the calculation of effective interactions for use in shell model calculations. Beginning with a basic perturbation theory framework, a brief review is presented of the calculation of other effective operators, focusing primarily on effective quadrupole operators required for calculating E2 transitions and moments. Results of order-by-order calculations and partial summations are given. 9 figures. (SDF)

7872 PROBLEMS OF VIBRATIONAL NUCLEI. PROCEEDINGS OF THE TOPICAL CONFERENCE ON PROBLEMS OF VIBRATIONAL NUCLEI, ZAGREB, YUGOSLAVIA, SEPTEMBER 24—27, 1974. Alaga, G.; Paar, V.; Sips, L. (eds.). Amsterdam; Netherlands; North-Holland Publishing Company (1975). 466p. (CONF-740992—). $41.75.

From Conference on vibrational nuclei; Zagreb, Yugoslavia (23 Sep 1974).

Separate abstracts for twenty-three papers appear in Nuclear Science Abstracts, four of which appear also in ERDA Research Abstracts. (JPF)

7873 Equivalence between Feynman—Goldstone and particle-phonon diagrams for finite many-body systems. Bes, D.R. (Comision Nacional de Energia Atomica, Buenos Aires); Broglia, R.A. pp 1-14 of In Problems of vibrational nuclei. Alaga, G. (ed.). Amsterdam; North-Holland Publishing Co. (1975).

From Conference on vibrational nuclei; Zagreb, Yugoslavia (23 Sep 1974).

See CONF-740992—.

The equivalence between the description of the many-body finite nuclear system in terms of traditional Feynman diagrams involving only the Fermion degrees of freedom and of Feynman diagrams involving Fermions and phonons degrees of freedom is proved for a general two-body residual interaction. 7 figures. (auth)

7874 Collective model for transitional nuclei. von Bernus, L.; Greiner, W.; Rezwani, V.; Schweid, W.; Schneider, U.; Sedlmayr, M.; Sedlmayr, R. (Univ., Frankfurt am Main). pp 230-262 of In Problems of vibrational nuclei. Alaga, G. (ed.). Amsterdam; North-Holland Publishing Co. (1975).

From Conference on vibrational nuclei; Zagreb, Yugoslavia (23 Sep 1974).

See CONF-740992—.

The collective model developed by Gneuss and Greiner is discussed. The model describes the quadrupole degrees of freedom of the nuclear shape by an Hamiltonian depending on the quadrupole surface coordinates. Since no restrictions on the magnitude of the quadrupole deformation are imposed like in the vibrator model and the rotator-vibrator models, the model is also capable of describing transitional nuclei as limiting cases of nearly spherical and strongly deformed nuclei. The main constituent of the Hamiltonian of the model is the potential energy surface (PES) which gives the potential as a function of the quadrupole deformation. The PES of a large variety of even-even nuclei is already deduced from the experimental low energy spectra. The obtained PES reveal transitions from oblate to prolate and triaxial nuclear shapes in several rows of isotopes. This is the beginning of a "Periodic system of collective potentials", which summarizes the main collective features of nuclei in a very transparent way. 27 figures. (auth)

7875 Abnormal nuclear states and vacuum excitations. Lee, T.D. (Columbia Univ., New York). pp 696-718 of In Lepton and hardon structure. Vol. 12. Zichichi, A. (ed.). London; Academic Press Inc. (1975).

From International school of subnuclear physics; Erice, Italy (14 Jul 1974).

See CONF-740731—.

The structure of the vacuum is examined assuming the existence of a strongly interacting neutral spin-0 even-parity meson or resonance. Abnormal nuclear states, the sigma model, and pure vacuum excitation are considered. (JFP)

7876 Systematics of the population of rotational bands in deformed nuclei in the (n,γ) reaction. MacPhail, M.R.; Casten, R.F.; Kane, W.R. (Brookhaven National Lab., Upton, N.Y. (USA)). *Phys. Lett., B;* **58**: No. 1, 39-42(18 Aug 1975).

In the (n,γ) reaction, a striking regularity occurs in the populations of low-lying states belonging to the same rotational band: as a function of excitation energy the populations for successive spins lie on smooth curves which, for different bands, are essentially parallel. This systematic behavior offers a new tool for classifying states in deformed nuclei. (NL)

7877 Collective model description of transitional odd-A nuclei. I. The triaxial-rotor-plus-particle model. Meyer-ter-Vehn, J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). *Nucl. Phys., A;* **249**: No. 1, 111-140(8 Sep 1975).

The energy spectrum of an odd nucleon coupled to a triaxial rotating core has been calculated as a function of the deformation β, the asymmetry γ and the Fermi energy lambda/sub F/. Results are presented in a series of plots with the odd nucleon restricted to a single j-shell and the parameters covering the area which is of most interest for transitional odd-A nuclei in the A = 135 and the A = 190 mass regions. The results apply to unique-parity spectra which are based either on particle or hole states in a j = $^{11}/_{2}$ shell, but hold also for j = $^{9}/_{2}$ and j = $^{13}/_{2}$. In addition, results on moments and transition probabilities are given. The quasiparticle-rotor Hamiltonian is derived with special emphasis on the particle-hole symmetry. The analytic solution for the even triaxial rotor at $\gamma = 30^{0}$ is given. Concerning the odd-A spectrum, characteristics which can be tested experimentally are discussed, and a qualitative physical interpretation is given. In particular, band structures in the triaxial region and their approximate classification are pointed out. (NL)

7878 Collective model description of transitional odd-A nuclei. II. Comparison with unique parity states of nuclei in the A=135 and A=190 mass regions. Meyer-ter-Vehn, J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). *Nucl. Phys., A;* **249**: No. 1, 141-165(8 Sep 1975).

Recent experimental data on unique-parity spectra of odd-α nuclei in the A = 135 and A = 190 mass regions are compared in a systematic way with calculated energies and transition probabilities of a quasiparticle coupled to a rotating triaxial core. The comparison yields detailed evidence for triaxial shapes. Complex spectra of strongly coupled structure as well as decoupled structure and various intermediate types are reproduced by the model with core parameters β and γ determined from neighboring even nuclei. The coexistence of $\Delta I = 1$ band structures, seen in some of the experimental spectra, is explained as a consequence of the shape asymmetry. In the A = 190 region, the odd-A spectra confirm the existence of a gradual shape transition from prolate-type shapes (^{186}Os, $\gamma = 16^0$) to oblate-type shapes (^{198}Hg, $\gamma = 37^0$). Energies and lifetimes in A approximately 135 nuclei reveal prolate triaxial shapes with γ-values in the range 20^0 less than γ less than 30^0. Contrary to the expectation of very γ-soft, fluctuating shapes which is based on calculated potentials, the present work seems to indicate that a number of transitional nuclei may have rather stable triaxial shapes. (NL)

7879 Nuclear hydrodynamics. Bertsch, G.F. (Los Alamos Scientific Lab., N.Mex. (USA)). *Nucl. Phys., A;* **249**: No. 2, 253-268(15 Sep 1975).

Continuum equations are derived for nuclear motion in the framework of time-dependent Hartree-Fock theory. The equations describe an elastic medium at low frequencies and independent particle motion at high frequencies. The giant quadrupole and monopole states are derived from the theory. The quadrupole energy in the Fermi gas model is given by E = [(h/2π)^2/m] [6k/sub F/^{2}/5 (r^2)]/sup $^1/_2$. The monopole energy depends on the details of the underlying Hartree-Fock theory. For higher multipoles, the theory only gives a mean energy of the strength function. The Wigner density matrix of the theory is derived. From this it is argued that all modes except the giant quadrupole and monopole are subject to Landau damping. (NL)

NUCLEAR REACTIONS AND SCATTERING

7880 (ORO—4856-3) **Colliding heavy ions: nuclei as dynamical fluids.** Griffin, J.J.; Kan, K.K. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). Sep 1975. 41p. (CONF-7410143—1). Dep. NTIS $5.00.

From Meeting of the American Physical Society; Pittsburgh, Pennsylvania, USA (31 Oct 1974).

Heavy ion experiments are already enriching nuclear science with a tapestry of new phenomena which demand explanation. In response, theoretical nuclear physics is rapidly expanding its insights to encompass these new observations, especially those concerned with the macroscopic aspects. Preliminary theoretical studies already suggest that the dynamical nuclear fluid must sometimes be considered viscous, compressible, and/or rotational if its microscopic properties are to be encompassed. These and some threads already well placed in the picture will be discussed. Other reasons will be cited to support the expectation that theoretical nuclear macroscopists may more and more come to be fluid dynamicists who specialize in those few thousand fluids called nuclei. Three such reasons are (a) the promised richness of their structure as dynamical fluids, (b) their unique prospect, among all the objects of modern physical science, of allowing complete microscopic, as well as phenomenological macroscopic, descriptions and (c) the possible overflow of such nuclear implications into classical fluid theory, from the viewpoint of which the nuclear heavy ion data are a significant novelty. 24 figures. (auth)

7881 INVESTIGATION OF NUCLEAR STRUCTURE BY SCATTERING PROCESSES AT HIGH ENERGIES. PROCEEDINGS OF THE INTERNATIONAL SCHOOL OF NUCLEAR PHYSICS, ERICE, SICILY, ITALY, 22 SEPTEMBER—1 OCTOBER 1974. Schopper, H. (ed.). Amsterdam; Netherlands; North-Holland Publishing Co. (1975). 364p. (CONF-7409109—). $33.25.

From International school of nuclear physics, the investigation of nuclear structure by scattering processes at high energies; Erice, Italy (22 Sep 1974).

Abstracts for eight papers have been prepared for appearance in NSA, one of which also appears in ERDA Energy Research Abstracts (ERA). (SDF)

7882 Upper limits on polarization effects in nuclear collisions. Mohr, C.B.O. (Univ. of Melbourne). *Aust. J. Phys.;* **28**: 133-140(1975).

The increase in cross section for inelastic collisions due to polarization of the target by the projectile has an upper limit in a simple model. The usual treatment of core polarization in nuclear collisions gives a polarization potential which is too large because of the use of perturbation theory and the neglect of dynamic effects, and which is in phase with the direct coupling potential contrary to recent experimental evidence and to channel coupling theory. (auth)

7883 Calculation of Coulomb energies for uniform charge distributions of arbitrary shape. Davies, K.T.R.; Sierk, A.J. (Los Alamos Scientific Lab., NM). *J. Comput. Phys.;* **18**: No. 3, 311-325(Jul 1975).

Three distinct surface-integral formulas are derived for calculating the Coulomb energies of uniform charge distributions of arbitrary shape. Of particular interest is an equation obtained by applying Gauss' divergence theorem twice. It is shown that this equation can be simply transformed to another expression which has been widely used for calculating Coulomb energies, with this derivation implying a third formula. The three formulas are also expressed in cylindrical coordinates for charge distributions possessing axial symmetry. For such shapes, numerical studies are presented showing the computational times and errors involved in calculating the Coulomb energies and generalized forces using Gaussian-Legendre quadrature formulas. It is shown that the double-divergence-derived formula is faster and more accurate than the other two surface-integral formulas and other formulas used in the literature. (auth)

7884 Qualitative behavior of heavy-ion elastic scattering angular distributions. Fuller, R.C. (Brookhaven National Laboratory, Upton, New York 11973). *Phys. Rev., C;* **12**: No. 5, 1561-1574(Nov 1975).

To study the qualitative features of elastic scattering in the presence of strong absorption, the scattering amplitude is decomposed into what the semiclassical approach calls positive- and negative-deflection-angle contributions. For an amplitude obtained from partial-wave summation this is done without approximation by considering the two amplitudes corresponding to the decomposition of each Legendre polynomial into its two traveling-wave components. It is necessary to consider separately the amplitude arising from the infinite-range Coulomb interaction which does not admit a partial-wave expansion. To decompose this amplitude we follow an approach which leads to increased understanding of the "diverging lens" effect of the Coulomb field and the related Fraunhofer and Fresnel diffraction structure of angular distributions. In addition, the absence or presence of oscillation at back angles is shown to be related to the dominance of reflective or "encirclement" scattering. By examining the phase of the positive-deflection-angle contribution to the scattering amplitude, we are able to conclude, in agreement with Frahn, that the smooth fall in tandem heavy-ion elastic angular distributions arises from a diffractive shadow and not a refractive or Coulomb-rainbow shadow. (AIP)

7885 Pion elastic scattering from aligned targets. Iverson, M.S.; Rost, E. (Nuclear Physics Laboratory, Department of Physics and Astrophysics, University of Colorado, Boulder, Colorado 80302). *Phys. Rev., C;* **12**: No. 5, 1589-1594(Nov 1975).

The differences in the interactions of π^+ and π^- particles with neutrons and protons can be used to investigate relative neutron and proton densities in nuclei. The use of aligned targets with π^+ and π^- beams presents considerable advantages for the extraction of neutron density information. As a framework for estimating pion scattering from aligned targets we use the Kisslinger optical potential including a deformed nucleon density distribution. The difference between aligned and unaligned differential cross sections (deformation effect) is found to be linear in β and allows for the extraction of neutron density shape information. (AIP)

7886 Field-theoretic low equation approach to pion-nucleus scattering. Cammarata, J.B.; Banerjee, M.K. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). *Phys. Rev., C;* **12**: No. 5, 1595-1606(Nov 1975).

From the pion-nucleus Low equation in the one-meson approximation we obtain an uncoupled, nonlinear, singular integral equation to determine the crossing symmetric elastic pion-nucleus scattering amplitude. The driving term of this equation is evaluated in an impulse single-scattering approximation for (J/sup π/ = 0^+, I = 0) ground state nuclei. It is found that unitarity requires that we include the effects of the strong absorption of the low partial waves in the entrance and exit channels. Thus, we introduce distortion of the pion waves by a procedure used in the inelastic peripheral scattering of elementary particles. Numerical results are presented for the iterative solution of this equation for π-^{12}C scattering in the energy region of the (3,3) resonance. (AIP)

RADIOACTIVE DECAY

7887 K-electron ejection in β^- decay: P/sub K/ or 1/2P/sub K/. Freedman, M.S. (Argonne National Lab., Ill. (USA)). *Nucl. Phys., A;* **249**: No. 1, 182-184(8 Sep 1975).

It is argued that a recent claim that there is an error of a factor of two in the Law-Campbell theory of K-electron shake-off in β^- decay is wrong. (NL)

NUCLEAR MODELS

7888 (LBL—4000, pp 154-157) **Nuclear Seyler—Blanchard model in the Hartree approximation.** Randrup, J. (Univ. of Aarhus, Denmark). Jul 1975.

In Nuclear chemistry. Annual report, 1974.

RADIATION AND SHIELDING PHYSICS

RADIATION PHYSICS

7889 (CONF-741040—P1, pp 97-119) **Use of a 3-MV proton accelerator for study of noble gases, including laser ionization of excited states.** Hurst, G.S.; Judish, J.P.; Nayfeh, M.H.; Parks, J.E.; Payne, M.G.; Wagner, E.B. (Oak Ridge National Lab., TN). 1974.

From 3. conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In Proceedings of the third conference on application of small accelerators. Volume I. The use of small accelerators in research and teaching.

The use of a pulsed 3-MV accelerator to study energy pathways in the noble gases is described. The objectives of pathways research are to obtain (1) information on the spectrum of excited states produced by a charged particle in a noble gas, (2) the rate of decay of the various states through various channels as a function of gas pressure, and (3) the modification of the decay channels due to the introduction of foreign species. A new energy pathways model is presented for helium as a general illustration. A method for the study of excited states, using a laser ionization technique is reported. Use is made of a laser which is tuned to a resonance transition between the desired excited state and some higher excited state. Photons in the same pulse photoionize the higher excited state; thus the ionization current vs photon wavelength has a resonance structure. Absolute yields of selected excited states can be obtained whenever the photon fluence per pulse is large enough to saturate the ionization current. A general summary is given of experimental facilities which include a 3-MV Van de Graaff accelerator, electronics for measuring radiation lifetimes, vacuum ultraviolet spectrometers, and a pulsed laser facility for direct study of excited states. Finally, the relevance of pathways research to (1) the interaction of radiation with matter, (2) the development of gas lasers, and (3) methods of ultrasensitive elemental analysis is pointed out. (auth)

7890 (CONF-741040—P1, pp 410-418) **States of energetic ions in solids.** Datz, S. (Oak Ridge National Lab., TN). 1974.

From 3. conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In Proceedings of the third conference on application of small accelerators. Volume I. The use of small accelerators in research and teaching.

Some new information relating to the atomic states and interactions of ions as they penetrate solids is presented. The demonstrated dependence of x-ray production cross sections upon ionic charge state is utilized by an ORNL-UT group as a measure of the charge on the ion penetrating a solid. In other work by an ORNL group it is shown that high velocity 0 ions (28 to 40 MeV) undergo very little charge exchange while passing through channels in Ag. Measurement of the stopping power for these particles is used to assess the effects of screening.

7891 (COO—881-443) **Effect of dispersion on wake bound electron states in metals.** Day, M.H. (Wisconsin Univ., Madison (USA). Dept. of Physics). Feb 1975. 13p. Dep. NTIS $4.00.

Using a dispersive dielectric function for the response of the electron gas, the induced potential along the path of a fast ion in a metal is calculated. From this, geometrical and binding information for the states of electrons which this potential may bind are determined. (auth)

7892 Proton stopping powers: binary encounter calculations based on accurate speed distributions for target electrons. Newton, M.D. (Brookhaven National Lab., Upton, N.Y. (USA)); Lucas, L.L.; Root, J.W. (California Univ., Davis (USA). Dept. of Chemistry). *Chem. Phys. Lett.;* **34**: No. 3, 552-556(1 Aug 1975).

Atomic and molecular electronic stopping powers for medium energy protons (approximately 10 keV—10 MeV) have been calculated using the binary-encounter approximation in conjunction with (1) either an energy or maximum impact parameter cutoff based on minimum excitation energies; and (2) ab initio electronic speed distributions. The maximum impact parameter approach yields good agreement with experiment for inert gases and closed shell polyatomic molecules comprised of first row atoms. (auth)

7893 (SLAC-Trans—170) **Mechanism of enhancement of controllable secondary-electron emission from fast single electrons.** Lorikyan, M.P.; Kavalov, R.L.; Trofimchuk, N.N.; Arvanov, A.N.; Gavalyan, V.G. (Erevanskij Fizicheskij Inst. (USSR)). Nov 1975. Translation of EFI—131(75). 30p. Dep. NTIS $4.00.

For porous KCl films (density approximately 2 percent, thickness 50-400 μm), the controllable secondary electron emission (CSEE) from fast single electrons with energies of 0.7-2 MeV was studied. An electric field E of approximately 10^4-10^5 V/cm was set up inside the porous films and the emission curves anti sigma = f(E) and the energy spectra of the secondary electrons were measured. The mean emission coefficient anti sigma increases with increasing E, reaching a value of anti sigma approximately equal to 230. Internal enhancement of CSEE under the action of the E field is explained by a process similar to the Townsend semi-self-maintained discharge in gases. The mean free path L/sub e/ of the secondary electrons estimated on the basis of this mechanism of CSEE enhancement is in good agreement with the L/sub e/ value obtained independently from the energy spectra of the secondary electrons. The report examines the effect of the first critical potential U/sub il/ and of the electron affinity of the dielectric α on the formation of CSEE from a porous dielectric film. The possibility of using such films in particle detectors is discussed. (auth)

7894 Stopping cross sections for helium and hydrogen in H_2, N_2, O_2, and H_2S (0.3 to 2.5 MeV). Langley, R.A. (Sandia Laboratories, Albuquerque, New Mexico 87115). *Phys. Rev., B;* **12**: No. 9, 3575-3583(1 Nov 1975).

Ion backscattering has been developed recently as a microanalytical technique for depth microscopy and mass analysis in solids. To establish an absolute depth scale in such studies, the energy loss rate of the ion in the constituents of the solid must be accurately measured. Hydrogen, nitrogen, oxygen, and sulphur are often important components of thin solid films; therefore, it is of interest to measure the stopping cross sections of H_2, N_2, O_2, and H_2S. A new technique has been developed to accomplish the measurement of the stopping cross sections of high-energy ions (>300 keV) in gases. The technique minimizes end-effect problems by passing the ions through a long gas cell and eliminates count-rate difficulties by detecting these ions after they have scattered from a thin Au film. This technique has been used to obtain stopping cross sections for 0.3—2.5-MeV protons and He ions in H_2, N_2, O_2, and H_2S to an uncertainty of less than +- 2%. The first stopping cross sections for S are derived by means of Bragg's rule and found to be appreciably greater than currently available theoretical or empirical values. (AIP)

SHIELDING CALCULATIONS AND EXPERIMENTS

7895 (CONF-751063—1) **Sensitivity analysis development and applications program at ORNL.** Oblow, E.M. (Oak Ridge National Lab., Tenn. (USA)). 1975. 47p. Dep. NTIS $5.00.

From Specialists' meeting on sensitivity studies and shielding benchmarks; Paris, France (7 Oct 1975).

The cross-section sensitivity analysis program at ORNL is reviewed with emphasis on present computer code capabilities and fast successful applications in the radiation shielding area. The FORSS sensitivity code system is discussed in regard to objectives, methodology, and code specifications. Examples of past shielding applications of FORSS emphasize the success of fine energy grid sensitivity studies and group structure selection, the use of evaluated error file and problem uncertainty estimation, two-dimensional shield sensitivity analysis and integral experiment design for fast reactors, data studies for the LMFBR program related to sodium and iron evaluations and iron data problems in CTR shielding design. Conclusions are drawn about the adequacy of present ENDF/B data files for sodium and iron and the general applicability of sensitivity studies in future design and analysis. 16 figures, 3 tables (auth)

MEDICAL PHYSICS

RADIATION PROTECTION STANDARDS

7896 **Use of animal data in derivation of standards.** Brues, A.M. (Argonne National Lab., IL). *Health Phys.*; **29**: No. 4, 521-524(Oct 1975).

From Proceedings of the second Los Alamos life sciences symposium; Los Alamos, NM, USA (22 May 1974).

Some of the more important concepts used in the derivation of radiation standards, and problems in their application, are reviewed. In particular, the application of various models for carcinogenesis and the influence of differing cell susceptibilities for various sizes of animals are considered. (auth)

DOSIMETRY

7897 (ORNL—5046, pp 205-206) **Tabulations of average dose equivalent due to residence of radionuclides in body organs of an adult.** Snyder, W.S.; Ford, M.R.; Warner, G.G.; Watson, S.B. Sep 1975.

In Health Physics Division annual progress report for period ending June 30, 1975.

Background information is given about the phantoms and methodology used in generating ORNL-5000 (A Tabulation of Dose Equivalent per Microcurie-Day for Source and Target Organs of an Adult for Various Radionuclides). (GHT)

7898 (ORNL—5046, pp 259-261) **Maternal, fetal, and pediatric phantoms.** Hwang, J.L.; Poston, J.W.; Shoup, R.L.; Warner, G.G. Sep 1975.

In Health Physics Division annual progress report for period ending June 30, 1975.

Development of pediatric phantoms for one year old and five year old children is described. Dimensions of the phantoms are given along with masses and volumes of the internal organs used in each. 2 figs., 2 tables. (GHT)

7899 (ORNL—5046, pp 262-263) **Outline of experimental programs using the MR. ADAM phantom.** Stansbury, P.S.; Poston, J.W. Sep 1975.

In Health Physics Division annual progress report for period ending June 30, 1975.

In addition to absorbed fraction measurements, the MR ADAM phantom is being used in three other areas. One program involves the whole body counting of ^{239}Pu in the lungs. Another program pertains to the dosimetry of /sup 99m/Tc in the liver and spleen. The third program area is spectrometry in the phantom exposed to x rays typical of medical diagnostic radiology. Progress in these areas is briefly described. (GHT)

7900 (UCRL—76904) **Design criteria for phantoms for calibration of external detectors for the in-vivo assay of plutonium.** Dean, P.N.; Griffith, R.V.; Anderson, A.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 6 Jun 1975. 5p. (CONF-751205—1). Dep. NTIS $4.00.

From IAEA international seminar on diagnosis and treatment of incorporated radionuclides; Vienna, Austria (8 Dec 1975).

Problems associated with calibration and standardization of existing phantoms for measurement of plutonium isotopes in the lungs are discussed. The efforts of the "Intercalibration Committee for Low-Energy Photon Measurements" to design a standard phantom are described. Two approaches to the design are described and design details are given. (GHT)

7901 (EUR—5273d-e-f(Vol.2), pp 627-662) **International neutron dosimetry intercomparison.** Goodman, L.J. (Columbia Univ., New York); Colvett, R.D.; Caswell, R.S. Mar 1975.

From 2. symposium on neutron dosimetry in biology and medicine; Neuherberg;Munich, F.R. Germany (30 Sep 1974).

In Proceedings of second symposium on neutron dosimetry in biology and medicine. II.

Fourteen groups of scientists, from six countries, performed measurements to determine the separate neutron and photon (x- and gamma-ray) tissue kermas in free air for four energies of monoenergetic neutrons, 15.5, 5.5, 2.1, and 0.67 MeV, and for a source of fission neutrons, ^{252}Cf. For the two highest energies, measurements were also made to determine the separate absorbed doses in tissue of neutrons and of photons at three depths in a large water phantom. (auth)

7902 (EUR—5273d-e-f(Vol.2), pp 681-731) **Calculations of the transport of fast neutrons (< or approx. = 50 MeV) through matter.** Alsmiller, R.G. Jr. (Oak Ridge National Lab., TN). Mar 1975.

From 2. symposium on neutron dosimetry in biology and medicine; Neuherberg;Munich, F.R. Germany (30 Sep 1974).

In Proceedings of second symposium on neutron dosimetry in biology and medicine. II.

The data and methods which are available to carry out coupled neutron-photon transport calculations at neutron energies less than or equal to 50 MeV are discussed. The emphasis is on those problems involving the higher neutron energies (less than or equal to 15 to 20 MeV) and on those problems requiring charged-particle spectra produced by neutron-nucleus collisions. Much of this discussion, therefore, is centered about the code HETC which is capable of solving such problems. Calculated results on absorbed dose, LET spectra, cell-survival probabilities, OER's, and RBE's for several neutron spectra incident on a tissue-equivalent phantom are presented, and some comparisons between calculated results and experimental data are given. A few comparisons are also given for LET spectra, OER's, and RBE's for photons, neutrons, negatively charged pions, protons, and alpha particles incident on a tissue phantom. All of the cell-inactivation calculations were carried out using the model of Katz et al. and parameters appropriate to T-1 kidney cells. 16 fig, 8 tables, 64 refs. (auth)

SOLID STATE PHYSICS

7903 (BNL—20598) **Virtual spin waves in itinerant ferromagnets above T/sub c/.** Klenin, M.A.; Hertz, J.A. (Brookhaven National Lab., Upton, N.Y. (USA)). 1975. 6p. (CONF-751209—14). Dep. NTIS $4.50.

From 21. annual conference on magnetism and magnetic materials; Philadelphia, Pennsylvania, USA (9 Dec 1975).

A microscopic calculation of the dynamic susceptibility in itinerant (Hubbard-like) paramagnets is carried out using a reformulation of an earlier theory which retains rotational invariance explicitly. Because the fluctuating order parameter has the character of a three-dimensional vector field, the susceptibility calculated within a generalized Hartree theory is found to include both transverse (spinwave-like) and longitudinal (Stoner-like) response. The results differ from those of the RPA through the appearance of propagating spinwave-like collective modes and through a virtual spin splitting of the single particle density of states, as well as through the smearing of the single-particle band structure which was previously reported. Damping occurs because of the analytic form of the Stoner-like part and because of fluctuations of the effective gap parameter entering into the spinwave part. (auth)

7904 (IFTJ—72/PS) **Determination of magnetic space groups.** Kucab, M. (Institute of Physics and Nuclear Techniques, Krakow (Poland)). 1975. 11p. Dep. NTIS (US Sales Only) $3.50.

A brief discussion of a method for determining the magnetic space group (Shubnikov group) for a given magnetic structure is presented. (auth)

7905 (LBL—4170) **Resonant Raman scattering near excitonic transitions.** Shen, Y.R. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1975. Contract W-7405-ENG-48. 32p. (CONF-750582—1). Dep. NTIS $5.00.

From Soviet-American symposium on theory of light scattering in solids; Moscow, USSR (26 May 1975).

The cases of Cu_2O and MnF_2 are used to illustrate the principles and usefulness of the resonant Raman technique. It is shown that the resonant Raman results can give not only a better understanding of the phonon (magnon) structure but also more details about the excitonic structure and the coupling between excitons (or electrons and holes) and phonons (magnons). (auth)

7906 (LBL—4178) **Nonlinear optical study of pretransitional behavior in liquid crystalline materials.** Shen, Y.R. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1975. Contract W-7405-ENG-48. 16p. (CONF-7506104—2). Dep. NTIS $4.50.

From Proceedings on nonlinear optical spectroscopy; Varenna, Italy (30 Jun 1975).

A case is discussed in which the optical Kerr effect is used to probe the pretransitional behavior of the isotropic yields nematic transition in a liquid crystal. The experimental arrangement to carry out such a measurement is described. (GHT)

7907 **Critical properties of many-component systems.** Emery, V.J. (Brookhaven National Lab., Upton, NY). *Phys. Rev., B;* **11**: No. 1, 239-247(1 Jan 1975).

Critical properties are discussed for systems with order parameters given by n vectors S/sub a/, each with m components. The Hamiltonian has an arbitrary symmetry for each vector separately, but there is a particular kind of coupling between them. It is shown that there is an integral representation for the partition function which reduces n to an explicit parameter in an averaged

partition function for the m-component model. This leads to a simple discussion of properties of the system as a function of n. In particular, it is possible to give a coherent derivation of several known and new results without the aid of perturbation theory or the renormalization-group method. It is shown that, in certain special cases, the exponents are Gaussian when n is a negative even integer and that n = 0 corresponds to the excluded-volume problem. The general case is shown to reduce to an arbitrary m-component model which is random when n = 0 and constrained when n yields infinity. A direct derivation of the large-n limit is given and leads to a variety of exactly solvable models. Expressions for the order n^{-1} correction are obtained in terms of correlation functions. This expansion is valid at all temperatures and for any order of transition, so that it is particularly suitable for considering tricritical phenomena. (auth)

7908 Mean-field calculation of the central peak due to the phonon-Ising dynamic crossover. Murata, K.K. (Brookhaven National Lab., Upton, NY). *Phys. Rev., B;* **11**: No. 1, 462-477(1 Jan 1975).

A self-consistent numerical calculation of the onset of the central mode in a phonon phi⁴ field theory, for T > T/sub c/, has been carried out. The central mode is attributed to crossover to Ising-like tunneling behavior, which is driven by indirect coupling to a collective excitation, corresponding to damped or overdamped second sound. Under the restrictive assumption that the central mode does not overlap the phonon sidebands, the self-consistency equation for the intensity parameter delta is found analogous to the BCS "gap" equation. Far from T/sub c/, delta is identically zero. After onset above T/sub c/, a 20—30% further change in coherence length is found sufficient for transfer of 80% of the phonon intensity into the central mode. The characteristic width of the (assumed Lorentzian) central mode is initially much broader than the phonon width, until about 80% intensity transfer occurs. Thereafter, critical narrowing is found to be anomalous. The formation of the central mode is characterized by a second short fluctuation length presumably controlling the surface energy between virtual domains. The (nonlocal) collective excitation presumably describes slow fluctuations into these virtual domains. The spectrum of the local two-phonon correlation function is found not to reflect the collective excitation but faster and more complicated-zero-point motion which is not analyzed here. An extension of the calculation to resolve this spectrum and other possible structure in the central mode is not out of the question, but this will be left for future calculation.

THEORETICAL PHYSICS

GENERAL AND MISCELLANEOUS

7909 Damping of a simple pendulum. Crawford, F.S. (Univ. of California, Berkeley). *Am. J. Phys.;* **43**: No. 3, 276-278(Mar 1975).

The simple pendulum is treated for the case in which the damping force is assumed to be proportional to v/sup p/, p unknown. The small-damping approximation is used throughout the work. An expression involving gamma functions is obtained for ΔA/A, the fractional decrease in the amplitude of pendulum motion on a given swing. (RWR)

CLASSICAL AND QUANTUM MECHANICS

7910 Quantum mechanical and semiclassical description of a two-dimensional fission model. Massmann, H.; Ring, P.; Rasmussen, J.O. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). *Phys. Lett., B;* **57**: No. 5, 417-421(4 Aug 1975).

The penetration through a two dimensional fission barrier is investigated by a fully quantum mechanical coupled channel calculation and by a new semiclassical method. One finds a quantitative agreement. (auth)

7911 (ORO—4856-37) Gauge transformations and quantum mechanics (I): gauge invariant interpretation of quantum mechanics. Yang, K.H. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). Oct 1975. 39p. Dep. NTIS $4.00.

Quantum mechanical operators are interpreted according to their equations of motion. A gauge invariant interpretation of quantum mechanics is obtained by expanding the wave function (in an arbitrary gauge) in the orthonormal set of eigenfunctions of the particle's energy operator (in the same gauge) and by interpreting the resulting expansion coefficients as probability amplitudes. Although the gauge invariant interpretive scheme proposed is formulated for a nonrelativistic, spinless charged particle, the extension to the Dirac equation is straightforward. (auth)

7912 Discrete state perturbation theory via Green's functions. Rubinson, W. (Brookhaven National Lab., Upton, NY). *J. Math. Phys. (N.Y.);* **16**: No. 1, 50-53(Jan 1975).

The exposition of stationary-state perturbation theory via the Green's function method in Goldberger and Watson's Collision Theory is reworked in a way that makes explicit its mathematical basis. It is stressed that the theory consists of the construction of, and manipulations on, a mathematical identity. The perturbation series fall out of the identity almost immediately. The logical status of the method is commented on. (auth)

7913 Zero-temperature properties of matter and the quantum theorem of corresponding states: the liquid-to-crystal phase transition for Fermi and Bose systems. Nosanow, L.H.; Parish, L.J.; Pinski, F.J. (Univ. of Minnesota, Minneapolis). *Phys. Rev., B;* **11**: No. 1, 191-204(1 Jan 1975).

The zero-temperature properties of matter with an interaction pair potential of the Lennard-Jones form are studied in the context of the quantum theorem of corresponding states. In particular, the phase transition between the fluid and crystalline phases is studied for systems obeying either Fermi-Dirac or Bose-Einstein statistics. It is found that the solidification pressure of a Fermi system is much lower than that of a Bose system with the same mass and pair potential. We find that it is illuminating to extend the usual thermodynamic vaiable space to include the corresponding-states quantum parameter eta identical with h^2/m epsilon sigma^2 which is defined in the text. It is shown that phase transitions occur at zero temperature as eta is varied; in particular, a first-order liquid-solid transition is described in detail and a model is discussed in which a second-order magnetic transition occurs at a critical value of eta. It is suggested that the full complexity of the phase-transition behavior, which is observed at finite temperatures arising from various properties of the potential, will also be observed at zero temperature mainly as a fundamental consequence of the quantum-mechanical zero-point kinetic energy. (auth)

STATISTICAL PHYSICS AND THERMODYNAMICS

7914 Network thermodynamics: an overview. Perelson, A.S. (Los Alamos Scientific Lab., NM). *Biophys. J.;* **15**: 667-685(1975).

Network thermodynamics is described, and its application is demonstrated by considering examples in equilibrium and nonequilibrium thermodynamics. Interconnection of resistive and capacitive n-ports and some simple transport systems are discussed. Network ideas are applied to theoretical problems in chemistry to provide new insights into the structure of large chemical systems. The goal of the method is to understand how biological systems work. (12 figures) (RWR)

MATHEMATICAL PHYSICS

7915 Dual trees and resummation theorems. Friedberg, R. (Columbia Univ., New York). *J. Math. Phys. (N.Y.);* **16**: No. 1, 20-30(Jan 1975).

Various resummation theorems known for graphical expansions in statistical physics and field theory are exhibited as special cases of a single symmetrical, easily remembered theorem on a generalized structure named a dual tree. (5 figures) (auth)

7916 N-variable rational approximants and method of moments. Alabiso, C.; Butera, P. (Stanford Univ., CA). *J. Math. Phys. (N.Y.);* **16**: No. 4, 840-845(Apr 1975).

The method of moments is applied to pairs linear permutable self-adjoint operators A and B in a Hilbert space H. An approximate expression for the diagonal matrix elements of the operator $(1 - wA - zB)^{-1}$, where w, z are complex numbers, is taken as a guide to the definition of rational approximants from general formal power series in two variables. With an operator convergence theorem in a certain Hilbert space as a basis, the convergence of the approximants to analytic functions of two complex variables with the integral representation G(w,z) =integral∫ d sigma$(\alpha,\beta)/(1 - w\alpha - z\beta)$ is proved, under suitable restrictions on the positive measure sigma(α,β). The same approximation scheme can also be applied to the diagonal matrix elements of the operator $[(1 - wA)(1 - zB)]^{-1}$, leading to a different rational approximant which is proved to converge to functions with the integral representation $G(w,z) = \int\int d\,\text{sigma}(\alpha,\beta)/(1 - w\alpha)(1 - z\beta)$. In both cases the convergence is uniform on appropriate compact subsets of C^2. The extension to the n-dimensional case is straightforward for both approximants. The connections with a standard variational principle are also briefly discussed. (auth)

CONTROLLED THERMONUCLEAR RESEARCH

PLASMA RESEARCH

PLASMA CONFINEMENT AND HEATING

7917 (CONF-740642—) **Proceedings of the second topical conference on RF plasma heating, Lubbock, Texas, June 20—22, 1974.** (Texas Tech Univ., Lubbock (USA). Plasma Lab.). 1974. 259p. Dep. NTIS $9.00.

From 2. topical conference on RF plasma heating; Lubbock, Texas, USA (20 Jun 1974).

Separate abstracts were prepared for 31 papers and appear in NSA. Abstracts for 23 of the papers appear in ERDA Research Abstracts. (MOW)

7918 (CONF-740642—, pp A5.1-A5.7) **Plasma loading and wave generation for ICRH in the ST Tokamak.** Adam, J. (Princeton Univ., NJ); Getty, W.D.; Hooke, W.M.; Hosea, J.C.; Sinclair, R.M. 1974.

From 2. topical conference on RF plasma heating; Lubbock, Texas, USA (20 Jun 1974).

In Proceedings of the second topical conference on RF plasma heating.

Plasma loading and wave generation for two half-turn loops operating at 25 MHz are being investigated on the ST Tokamak at power levels up to 1 MW. The equivalent series resistance R/sub s/ = P/sub rf//I²/sub rf/, measured as a function of $\Omega = \omega/\omega_{ci}(r = 0)$ and plasma density, is found to be in good agreement with the predictions of the cylindrical theory. R/sub s/ values as high as several ohms are obtained at high densities giving wave generation efficiencies well above 90 percent. Loading near $\Omega = 1$ and 2 is apparently independent of power level. Measurements of B/sub zrf/ at 20 locations about the torus reveal the predicted wave generation; $m = 0, +1$ slow waves in the vicinity of $\Omega = 1$, $m = -1$ fast waves after the expected onset (usually Ω greater than or equal to 1), and $m = 0, +1$ fast waves for higher Ω. Toroidal eigenmodes accompanied by large loading are detected for the fast waves when the damping lengths are long. (auth)

7919 (CONF-740642—, pp B1.1-B1.10) **Survey of lower hybrid studies.** Oakes, M.E. (Univ. of Texas, Austin). 1974.

From 2. topical conference on RF plasma heating; Lubbock, Texas, USA (20 Jun 1974).

In Proceedings of the second topical conference on RF plasma heating.

A review of lower hybrid resonance work is presented and recent experiments producing significant ion heating are discussed. (auth)

7920 (CONF-740642—, pp B3.1-B3.9) **Measurement and analysis of resonance cone structure from a finite-sized source at the hybrid frequency.** Colestock, P.L.; Getty, W.D. (Univ. of Michigan, Ann Arbor). 1974.

From 2. topical conference on RF plasma heating; Lubbock, Texas, USA (20 Jun 1974).

In Proceedings of the second topical conference on RF plasma heating.

Experimental and theoretical investigations of wave propagation from a finite-sized source near the lower-hybrid frequency in an inhomogeneous plasma column are described. The wave is excited electrostatically by coaxial half-cylinders. In the present work, measurements of the rf potential show the occurrence of resonance cones along trajectories emanating from the ends of the cylinders as described for the finite source by Bellan and Porkolab. The numerical solution for an oscillating ring charge in a hot plasma has been obtained to determine the effects of T/sub e/ and T/sub i/ on the resonance cone structure. Results show a peak in the rf potential along the resonance cones in agreement with experiment. In addition, the numerical results show a short-wavelength, low-amplitude oscillation occurring on the low-density side of the resonance cone. (auth)

7921 (CONF-740642—, pp B4.1-B4.6) **Lower-hybrid heating in large tokamak.** Troyon, F.; Perkins, F.W. (Princeton Univ., NJ). 1974.

From 2. topical conference on RF plasma heating; Lubbock, Texas, USA (20 Jun 1974).

In Proceedings of the second topical conference on RF plasma heating.

The extension of heating techniques which rely on the excitation of an electrostatic wave in the vicinity of the lower-hybrid resonance frequency or higher to large, dense, and hot tokamaks meets new problems: (1) Linear damping on the electrons, and on the ions if T/sub i/ greater than or equal to T/sub e/, is very strong at temperatures of a few keV and impose a low value of N/sub parallel/, typically less than 2. (2) Accessibility requires N/sub parallel/ to be of the same order of magnitude leaving at best a narrow window. (3) Coupling structures excite a wide range of N/sub parallel/, only a fraction of which will heat the center. Excitation of the fast wave widens the accessible range but the larger evanescent layer near the coupler may present new problems. (auth)

7922 (CONF-740642—, pp B6.1-B6.6) **Lower hybrid resonance heating in a hot electron plasma.** Shohet, J.L.; Raimbault, P.A. (Univ. of Wisconsin, Madison). 1974.

From 2. topical conference on RF plasma heating; Lubbock, Texas, USA (20 Jun 1974).

In Proceedings of the second topical conference on RF plasma heating.

Electron and ion heating have been observed when rf at a frequency close to the lower hybrid resonance is coupled electrostatically into a hot electron plasma by means of an appropriate structure. The rf heating frequency is 10 MHz at a power of 500 W. The hybrid layer is identified with a rf interferometer correlated with density measurements. The electron temperature profile shows that the heating zone is located on the low density side of the hybrid layer. Plasma is expelled from the heating zone along the magnetic field lines. Relativistic electrons produced by the ECRH source at low pressure tend to limit the amount of electron heating by the rf, and a slight increase in ion temperature occurs as well. The maximum electron heating appeared to occur whenever the product of the perpendicular wave number and the electron gyro radius was approximately unity. (auth)

7923 (CONF-740642—, pp B7.1-B7.6) **Numerical simulation of lower hybrid resonance heating of a two-dimensional magnetized plasma.** Emery, M.H. (Univ. of Iowa, Iowa City); Joyce, G.; Shohet, J.L. 1974.

From 2. topical conference on RF plasma heating; Lubbock, Texas, USA (20 Jun 1974).

In Proceedings of the second topical conference on RF plasma heating.

The response of a two-dimensional magnetized plasma to excitation by an external field at the lower hybrid frequency is examined by numerical simulation. The ions are magnetized; the electrons are guiding center. It is concluded that (1) the heating is not collisional, (2) heating is greatest for $(k/k_{perpendicular}/\rho_{ci})^2$ approximately equal to 1, (3) heating is improved for frequencies slightly above the hybrid frequency, (4) and for ω_{ci}/ω_{pi} greater than 1, and (5) the heating is caused by excitation of a normal mode which leads to mode coupling and subsequent trapping of the ions. The results concur with those of Raimbault and Shohet. (auth)

7924 (CONF-740642—, pp C5.1-C5.6) **Overdense radio frequency source.** Bernabei, S.; Hooke, W.M.; Jassby, D.L.; Motley, R.W. (Princeton Univ., NJ). 1974.

From 2. topical conference on RF plasma heating; Lubbock, Texas, USA (20 Jun 1974).

In Proceedings of the second topical conference on RF plasma heating.

One of the more attractive techniques for the supplementary heating of large tokamak devices involves the application of radio frequency power near the lower hybrid frequency (LHF). The fundamental engineering advantages of this approach are twofold: (1) At frequencies corresponding to the LHF (1-3 GHz) in reactor-sized tokamaks, very powerful (approximately 0.5 MW, continuous wave) sources already exist. (2) The power may be transmitted to the plasma by means of waveguide, so that one has a "coil-less" rf injection system. The characteristics of the rf produced plasma were studied to develop the parametric gap between the test devices and the ATC Tokamak. (auth)

7925 (CONF-740642—, pp D2.1-D2.8) **Parametric instabilities and plasma heating near the lower hybrid frequency.** Chang, R.P.H. (Bell Labs., Murray Hill, NJ); Porkolab, M. 1974.

From 2. topical conference on RF plasma heating; Lubbock, Texas, USA (20 Jun 1974).

In Proceedings of the second topical conference on RF plasma heating.

Experimental and theoretical studies of a new type of parametric instability involving the excitation of ion quasi-modes (due to nonlinear wave-particle scattering) have been carried out when the "pump" frequency is near the lower-hybrid frequency. Plasma heating associated with this instability has also been measured. (auth)

7926 (CONF-740642—, pp D3.1-D3.6) **Experimental studies of plasma heating associated with parametric instabilities.** Aru-

nasalam, V.; Luhmann, N.C. Jr.; Porkolab, M.; Schmitt, J.P.M. (Princeton Univ., NJ). 1974.

From 2. topical conference on RF plasma heating; Lubbock, Texas, USA (20 Jun 1974).

In Proceedings of the second topical conference on RF plasma heating.

Experimental studies of plasma heating due to microwave irradiation of the magnetically confined plasma column in the Princeton L-3 device will be presented. X-band microwave power, both in the ordinary and extraordinary modes of propagation, was used in these experiments. Plasma heating has been observed to occur simultaneously with parametric decay instabilities. The mode structure of the pump wave and the decay ion wave dispersion have been measured by high frequency probes. Measurement of both electron and ion heating rates will be presented and compared with collisional heating rates. The localization of plasma heating and mode structure are discussed. (auth)

7927 (CONF-740642—, pp D6.1-D6.6) **Parametric heating of electrons by an electromagnetic wave.** Carlile, R.N. (Univ. of Arizona, Tucson). 1974.

From 2. topical conference on RF plasma heating; Lubbock, Texas, USA (20 Jun 1974).

In Proceedings of the second topical conference on RF plasma heating.

In a computer simulation study, the parametric heating of electrons when an electromagnetic pump wave propagates through the plasma parallel to the dc magnetic field was observed. The heating mechanism is parametric excitation of resonant electrostatic waves which trap electrons. Consequently, the electron distribution function develops a high velocity tail. The details of these processes are discussed. It was found that the energy of the electrons will increase by a factor of about 4. It is determined that the distribution function after heating will relax to Maxwellian in about 11 electron-electron collision times. (auth)

7928 (CONF-740642—, pp D8.1-D8.6) **Damping of the fast wave and plasma heating by an unidentified mechanism.** Dollinger, R. (Texas Tech Univ., Lubbock); Kristiansen, M.; Hagler, M.O.; Paoloni, F.J.; Bergstroem, J. 1974.

From 2. topical conference on RF plasma heating; Lubbock, Texas, USA (20 Jun 1974).

In Proceedings of the second topical conference on RF plasma heating.

Wave damping and plasma heating were observed for the fast (right-hand polarized) wave at a frequency below the second harmonic of the ion cyclotron frequency (Ω/sub i/) in a dense hydrogen plasma (n greater than $10^{20}/m^3$) in a mirror geometry. The wave is also observed to damp at the second harmonic. (auth)

7929 (CONF-740642—, pp E2.1-E2.5) **Theory and simulation of cyclotron heating in a linear octupole.** Sprott, J.C. (Univ. of Wisconsin, Madison). 1974.

From 2. topical conference on RF plasma heating; Lubbock, Texas, USA (20 Jun 1974).

In Proceedings of the second topical conference on RF plasma heating.

A simple conductivity model is used to calculate the cyclotron heating rate (electron or ion) in an arbitrary nonuniform magnetic field. The result is applied to an ideal linear octupole field, which, because of its complexity, offers a severe test of the theory. The theory is compared with the results of a numerical simulation in which the trajectories and average energy of a collection of noninteracting particles are calculated as a function of time. The theory and simulation are in surprisingly good agreement over a wide range of heating frequency, plasma temperature, electric field strength, and wave number. (auth)

7930 (CONF-740642—, pp E3.1-E3.6) **ECRH experiments in a toroidal octupole.** Wong, K.L.; Sprott, J.C. (Univ. of Wisconsin, Madison). 1974.

From 2. topical conference on RF plasma heating; Lubbock, Texas, USA (20 Jun 1974).

In Proceedings of the second topical conference on RF plasma heating.

Electron cyclotron heating rates were measured for low density plasmas (ω^2/sub p/ much less than ω^2) in a toroidal octupole by the sweep method with resonance zones situated near the minor axis of the toroid. The energy absorbed by the plasma from the 100 mW frequency sweep oscillator is determined from the broadening of the cavity modes. The heating rate is measured for different magnetic field strengths, electron temperatures, electron-neutral collision frequencies and plasma densities. The scaling of heating rate with plasma density is different from previous results of high frequency (10 GHz) cavity mode measurements. The difference is explained by the different positions of the resonance zones. (auth)

7931 (CONF-740642—, pp E4.1-E4.6) **ICRH experiments in a toroidal octupole.** Barter, J.D.; Sprott, J.C. (Univ. of Wisconsin, Madison). 1974.

From 2. topical conference on RF plasma heating; Lubbock, Texas, USA (20 Jun 1974).

In Proceedings of the second topical conference on RF plasma heating.

A 100 kW, 144 μsec pulse of 1.4 MHz rf is used to heat plasmas with densities less than or equal to 3×10^{12} cm^{-3} at the ion cyclotron frequency in a toroidal octupole. The rf is coupled to the plasma by a single turn, electrostatically shielded hoop coaxial to the four main hoops and located near the wall. Absorbed power is inferred from plasma loading of the hoop and measured directly with an electrostatic ion energy analyzer and compared to single particle resonance heating theory. (auth)

7932 (CONF-740642—, pp E10.1-E10.7) **Radio-frequency activated two-energy-component toroidal fusion reactors.** Jassby, D.L. (Princeton Univ., NJ). 1974.

From 2. topical conference on RF plasma heating; Lubbock, Texas, USA (20 Jun 1974).

In Proceedings of the second topical conference on RF plasma heating.

The maximum gain of a two-energy-component fusion reactor in which the hot component (D) is produced by rf heating is considered. In one ideal case, the fast wave at $\omega = 2\omega$/sub CD/ produces an energy distribution f(W) approximately constant that includes all deuterons, which then thermalize and react with the cold tritons. In another ideal case, f(W) approximately constant is maintained by the fast wave at $\omega = \omega$/sub CD/. In either case, the maximum gain is comparable to that of the beam-injection scheme. When one includes unavoidable rf inputs to bulk-plasma electrons and tritons, and the probability that many deuterons remain cold, the gain is substantially less than that of the beam-injection scheme. (auth)

7933 (JINR—P11-9113) **Mathematical modeling of the dynamic three-dimensional nonlinear problem of the physics of weakly turbulent plasma. II. Turbulent heating of the plasma by electromagnetic (laser) radiation and abnormal scattering of the radiation.** Getmanov, B.S.; Makhan'kov, V.G. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 17p. (In Russian). Dep. NTIS (US Sales Only) $4.50.

The problem of abnormal scattering of laser radiation on excited ion-sonic oscillations, leading to the study of the dynamics of ion-sonic turbulence with consideration of its angular distribution, was studied. Qualitatively it was shown and confirmed by numerical studies that the excited turbulence is weakly anisotropic and remains so all during the process of transfer of the oscillations into the long-wave region because of the induced scattering on ions; therefore the abnormal scattering is small. On the basis of the results obtained and results from previous studies it was concluded that the existence of isotropic spectra of weak turbulence in real conditions is problematic. (tr-auth)

7934 (LA—6044-PR, pp 42-53) **Staged Theta Pinch program.** Thomas, K.; Borkenhagen, W.; Call, D. Aug 1975.

In LASL Controlled Thermonuclear Research Program. Progress report, January—December 1974.

The resonant heating concept is discussed. The layout of the staged theta pinch experiment is described, i.e., construction and engineering. (MOW)

7935 (LA—6044-PR, pp 81-87) **Implosion heating experiment.** Hammel, J.E.; Henins, I.; Jarboe, T.R.; Marshall, J.; Sherwood, A.R. Aug 1975.

In LASL Controlled Thermonuclear Research Program. Progress report, January—December 1974.

The electrical circuit for the Implosion Heating Experiment (IHE) is described. Some failures in the system are discussed. Some diagnostic measurements using probes, image converter photography, and interferometry are mentioned. (MOW)

7936 (LA—6044-PR, pp 88-103) **Z-pinch program.** Baker, D.A.; Burkhardt, L.C.; DiMarco, J.N.; Forman, P.R.; Haberstich, A.; Howell, R.B.; Karr, H.J.; Phillips, J.A.; Schofield, A.E. Aug 1975.

In LASL Controlled Thermonuclear Research Program. Progress report, January—December 1974.

The past year was spent studying the characteristics of the toroidal reversed field Z pinch experiment ZT-1 between 10^{10} A/s and 2×10^{11} A/s. The modes of machine operation and formation of reversed field profiles are discussed. The electron temperature during the preionization phase is described. Density and temperature measurements are outlined. (MOW)

7937 (LA—6044-PR, pp 116-121) **Experimental plasma physics.** Dreicer, H.; Banton, M.E.; Brownell, J.H.; Ellis, R.F.; Ingraham, J.C.; Wright, B.L. Aug 1975.

In LASL Controlled Thermonuclear Research Program. Progress report, January—December 1974.

The program was devoted to the study of the plasma ac electrical resistivity and plasma heating produced by the application of hf electromagnetic radiation to fully ionized plasmas. Some data are given for the effect of intense ac electric fields on the electron—ion collision rate in a plasma. (MOW)

7938 (ORNL-tr—4027) **Role of impurities in anomalous resistance of plasma.** Kirillov, V.D.; Trubikov, B.A.; Trushin, S.A. Translated by Martha Gerrard from *Fiz. Plazmy;* **1**: No. 2, 218-237(1975). 24p. Dep. NTIS $4.50.

The process of deep ionization of heavy ion impurities in a discharge with increasing temperature, which permits determining the effective charge of the impurity ions, z/sub eff/ is considered. It is shown that the contribution to the resistance of the plasma is not only the coulomb collision of the electrons with ions of the impurities but also collision with electron shells of the ions. The results of numerical calculations of the concentrations of the impurities which may ensure the observed anomalies are described. There are five appendixes containing additional information on ionization, dispersion of electrons, and irradiation of impurities. The bremsstrahlung spectrum was calculated with consideration of the effect of the ion cores. (auth)

7939 **Diffraction losses in a laser-heated solenoid plasma.** Steinhauer, L.C. (Mathematical Sciences Northwest, Inc., Bellevue, Washington 98009). *J. Appl. Phys.;* **46**: No. 11, 4747-4749(Nov 1975).

A solution for diffraction loss of a laser beam propagating in a plasma light pipe is found by analogy to the tunnel effect of quantum mechanics. It is shown that diffraction tends to dissipate the beam layer by layer, working from the outside inward. A characteristic dissipation length can be defined for each layer of the beam. Diffraction is estimated for a very long narrow plasma relevant to the fusion reactor concept and is found not to be a significant loss mechanism. (auth)

7940 **Reduction of classical thermal conductivity under the influence of high-power lasers.** Pearlman, J.S.; Anthes, J.P. (Sandia Laboratories, Albuquerque, New Mexico 87115). *Appl. Phys. Lett.;* **27**: No. 11, 581-583(1 Dec 1975).

Observation of the front and rear plasma expansions from a laser-irradiated thin film has been used to study the thermal conduction of polystyrene targets. The existence of reduced conductivity has been inferred above a threshold of 10^{14} W/cm^2. The percentage of laser radiation transmitted through the thin film decreased by an order of magnitude as the laser flux increased from 10^{13} to 10^{14} W/cm^2. (AIP)

7941 **Electrical triggering of an optical breakdown plasma with subnanosecond jitter.** Kwok, H.S.; Yablonovitch, E. (Gordon McKay Laboratory, Harvard University, Cambridge, Massachusetts 02138). *Appl. Phys. Lett.;* **27**: No. 11, 583-585(1 Dec 1975).

We have shown that CO_2-laser-induced breakdown in ultraclean gas follows less than 1 nsec after the injection of free electrons into the focal volume. While this confirms our understanding of the plasma nucleation mechanisms, it is also the first example of a new class of electro-optic switch in which a small electrical signal is able to control the transmission of a powerful laser beam. (AIP)

PLASMA DIAGNOSTICS

7942 (COO—2229-10) **Space and time resolved measurements in magnetically confined plasmas using a heavy ion beam probe.** Jennings, W.C.; Hickok, R.L. (Rensselaer Polytechnic Inst., Troy, N.Y. (USA)). 1975. 4p. (CONF-750871—1). Dep. NTIS $4.50.

From 22. international conference of phenomena in ionized gases; Eindhoven, Netherlands (18 Aug 1975).

A heavy ion beam probe provides space and time resolved measurements of plasma density, space potential, electron temperature, and current density in energetic, magnetically confined plasmas. A new dual beam technique has been developed to separate density and electron temperature measurements by probing the plasma with two different ion species. An extension of this technique has been used in conjunction with a feedback controlled, electrostatic energy analyzer to yield the only direct, absolute measurement of plasma space potential. Calibration of the frequency response of the analyzer/detector system has permitted direct measurements of the amplitude and phase of both density and space potential oscillations associated with plasma instabilities. (auth)

7943 (COO—2444-1) **Ion beam probe diagnostic system for the LITE experiment.** Stufflebeam, J.H.; Jennings, W.C.; Hickok, R.L. (Rensselaer Polytechnic Inst., Troy, N.Y. (USA). Plasma Dynamics Lab.). Nov 1974. Contract AT(11-1)-2444. 9p. Dep. NTIS $3.50.

The problem of defocusing of the ion beam by the strong gradients in the magnetic field was discussed. It was shown this can be overcome by a linear field lens to shape the initial beam, or by proper selection of the size and position of the secondary ion detector. The results of the preliminary beam alignment were presented and the favorable comparison of the scaling formula and computer simulation was evident. (auth)

7944 (LA—6044-PR, pp 104-115) **Plasma diagnostics.** Jahoda, F.C.; Amsden, R.C.; Chandler, G.I. Aug 1975.

In LASL Controlled Thermonuclear Research Program. Progress report, January—December 1974.

The HF laser side-on holographic interferometry system for the pinch devices is described. An automated data processing and computer control system is discussed. Some plasma measurements using Thomson scattering are given. (MOW)

7945 (ORNL-TM—5071) **Proposed spatial ion temperature measurement with a FIR laser.** Hutchinson, D.P.; Vander Sluis, K.L. (Oak Ridge National Lab., Tenn. (USA)). Nov 1975. Contract W-7405-eng-26. 28p. Dep. NTIS $4.00.

A feasibility study for measuring the ion temperature in a thermonuclear type plasma by ion Thomson scattering is presented. The study indicates that the measurement is possible with predictable improvements in FIR laser power and FIR detector development. The possibility of measuring the effective charge anti Z of a plasma using the same techniques is discussed. (auth)

7946 (UCRL—77075) **Computer analysis of four channel x-ray microscopy images to obtain source and spectral emission data on laser fusion.** Harper, T.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 6 Oct 1975. Contract W-7405-Eng-48. 29p. (CONF-751130—13). Dep. NTIS $5.00.

From APS meeting; St. Petersburg, Florida, USA (10 Nov 1975).

It is possible to analyze the images obtained from the four-channel x-ray microscope to obtain reasonable estimates of source spatial and energy emission. The technique shown here is particularly useful when relative comparisons are desired in which, from shot to shot, few parameters are changed. These data are of use in fuel pellet design and in checking design code predictions. The technique should also apply to pinhole camera data. Largest uncertainties appear to be due to film energy/handling calibration and mirror efficiency measurements. (auth)

7947 (UCRL—77173) **Activation measurements of high energy deuterons in the plasma focus device.** Gullickson, R.L.; Sahlin, H.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 4 Dec 1975. 18p. (CONF-751130—17). Dep. NTIS $3.50.

From APS meeting; St. Petersburg, Florida, USA (10 Nov 1975).

Nuclear activation techniques were used to measure the fluence of high energy deuterons in a plasma focus device having a stored energy of 75 kilojoules at 18 kV. The $^{12}C(d,n)^{13}N$ (330 keV threshold) and $^{27}Al(d,p)^{28}Al$ reactions were used to provide both an absolute number of high energy deuterons and an average energy, evaluated from the $^{13}N/^{28}Al$ ratio calculated for various energies by Young. Previous measurements indicated more than 10^{15} deuterons could be accelerated to energies above 330 keV in the low pressure mode of operation, with a highly anisotropic distribution. Present measurements show that more than 10^{12} deuterons achieve energies greater than 5 MeV on some high intensity shots in the low pressure mode. The presence of multi-MeV deuterons in the plasma focus device was substantiated by measuring activation as a function of depth in 1 mil Al foils, and by measurements of neutron energy using time-of-flight. (auth)

7948 **Pulsed hf laser holographic interferometry.** Kristal, R. (Los Alamos Scientific Lab., NM). *Appl. Opt.;* **14**: No. 3, 628-633(Mar 1975).

Two-dimensional holographic interferometry has been accomplished at wavelengths near 3 μm. The source is a pulsed hydrogen fluoride oscillator-amplifier system. Transverse excitation is achieved with a fast bank discharging into a simple electrode configuration. The spatial detector is a thin film of bismuth, exposed by local evaporation by a single line of the HF laser emission spectrum. Double exposure interferograms covering areas up to approximately 10 cm^2 in the object plane have been obtained with single-line laser energies of less than a joule. (auth)

7949 (ORNL-tr—4047) **New method for local measurement of the effective charge and the ion density in a tokamak.** Dei-Cas,

R. Aug 1975. Translation of EUR-CEA-FC—775. 15p. Dep. NTIS $4.50.

A new method is proposed to measure the local effective charge and the local ion density in a tokamak plasma. The method is based on the measurement of the local captured fraction of a fast neutral beam injected. (auth)

PLASMA KINETICS - GENERAL

7950 (CONF-741040—P1, pp 253-258) **Atomic and nuclear cross section needs for the controlled thermonuclear research program.** Barnett, C.F. (Oak Ridge National Lab., TN). 1974.

From 3. conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In Proceedings of the third conference on application of small accelerators. Volume I. The use of small accelerators in research and teaching.

Specific atomic and nuclear physics problems related to controlled fusion research are reviewed. In atomic physics problem areas to be discussed are as follows: plasma diagnostics, plasma heating, and cooling. Areas needing numerical nuclear data are charged particle reactions involving advanced fuel cycles and cross sections for 14 MeV neutrons. (auth)

7951 **Ion-induced pinch and the enhancement of ion current by pinched electron flow in relativistic diodes.** Goldstein, S.A.; Lee, R. (University of Maryland, College Park, Maryland 20742). *Phys. Rev. Lett.*; **35**: No. 16, 1079-1082(20 Oct 1975).

A new model for time-dependent and steady-state ion and electron flow in large-aspect-ratio diodes is constructed. The electron trajectories are computed with use of the self-consistent fields calculated during the initial ion motion. The dynamic formation of a tightly pinched electron flow is qualitatively explained. Very large ion currents, nearly equal to the electron current, are predicted for flat solid cathodes, when steady-state flow is achieved. (AIP)

7952 **H^- shape-resonance studies in an arc plasma.** Ott, W.R.; Slater, J.; Cooper, J.; Gieres, G. (Institute for Basic Standards, National Bureau of Standards, Washington, D.C. 20234). *Phys. Rev., A;* **12**: No. 5, 2009-2016(Nov 1975).

Calculation by Macek have shown that the H^- photoabsorption cross section should be affected by a shape resonance at 1129.5 A. This experiment is an attempt to observe the resonance in emission according to the reaction e + H yields H^{-*} yields H^- + hν. The plasma is in a condition of local thermodynamic equilibrium and is generated by a stationary wall-stabilized hydrogen arc. With an axis temperature of 14 000 K and 1 atm pressure, the H^- free-bound continuum contributes only about 2% of the total radiation which is dominated in the 1130-A region by the Ly-α wing. However, the peak of the shape resonance, according to Macek, should have a cross section about 25 times greater than the continuous free-bound cross section; therefore, it should appear as a very noticeable 50% structure superimposed on the Ly-α wing. Except for some small features which are attributed to weak molecular emission, there is no obvious indication of the shape resonance in either deuterium or hydrogen spectra between 1105 and 1135 A. It is estimated that the minimum feature which could have been detected at 1129 A was about 2% of the total signal. (AIP)

7953 **Influence of anode composition on the electrical properties of relativistic electron-beam diodes.** Kelly, J.G.; Goldstein, S.A.; Swain, D.W. (Sandia Laboratories, Albuquerque, New Mexico 87115). *J. Appl. Phys.*; **46**: No. 11, 4726-4729(Nov 1975).

Current, voltage, x-ray, and witness plate measurements of the diode characteristics of the Nereus accelerator (150 kV, 50 kA) have shown that the composition of the anode can have a profound effect on the properties of the electron beam. In particular, if the anode is heated to remove absorbed gases and volatile impurities, the diode impedance holds up longer than in the case of an anode having an unprepared surface or one that has been covered with an easily vaporized low-Z substance (which leads to very rapid diode shorting). The fact that the anode surface can influence the electron current less than 10 ns into the beam pulse, before space-charge-limited electron flow has been established, indicates that ions, plasmas, or photons are generated at the anode and cross the diode gap before the electron beam has deposited more than 1 cal/cm^2 into the anode. (AIP)

PLASMA KINETICS - EXPERIMENTAL

7954 (CONF-740642—, pp E5.1-E5.7) **Anamalous resistivity due to intermediate-frequency fields.** Conrad, J.R.; Gore, R.; Lashinsky, H. (Univ. of Maryland, College Park). 1974.

From 2. topical conference on RF plasma heating; Lubbock, Texas, USA (20 Jun 1974).

In Proceedings of the second topical conference on RF plasma heating.

The production of anomalous resistivity in a Q-machine plasma by a large amplitude, longitudinal rf electric field is described. Noncontact diagnostics have been developed to measure the longitudinal and azimuthal components of the resistivity. The implication of these measurements with regard to proposed "catalytic heating" of toroidal plasmas is described. (auth)

7955 **Vacuum arc anode plasma. I. Spectroscopic investigation.** Bacon, F.M. (Sandia Laboratories, Albuquerque, New Mexico 87115). *J. Appl. Phys.*; **46**: No. 11, 4750-4757(Nov 1975).

A spectroscopic investigation was made of the anode plasma of a pulsed vacuum arc with an aluminum anode and a molybdenum cathode. The arc was triggered by a third trigger electrode and was driven by a 150-A 10-μs current pulse. The average current density at the anode was sufficiently high that anode spots were formed; these spots are believed to be the source of the aluminum in the plasma investigated in this experiment. By simultaneously measuring spectral emission lines of Al I, Al II, and Al III, the plasma electron temperature was shown to decrease sequentially through the norm temperatures of Al III, Al II, and Al I as the arc was extinguished. The Boltzmann distribution temperature T/subD/ of four Al III excited levels was shown to be kT/subD//e=2.0plus-or-minus0.5 V, and the peak Al III 4D excited state density was shown to be about 5times10^{17} m^{-3}. These data suggest a non-local-thermodynamic-equilibrium (non-LTE) model of the anode plasma when compared with the Al^{3+} production in the plasma. The plasma was theoretically shown to be optically thin to the observed Al III spectral lines. (auth)

PLASMA KINETICS - THEORETICAL

7956 (JINR—P11-9112) **Mathematical modeling of the dynamic three-dimensional nonlinear problem of the physics of weakly turbulent plasma. I.** Getmanov, B.S.; Makhan'kov, V.G. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 20p. (In Russian). Dep. NTIS (US Sales Only) $4.50.

The dynamics of weak anisotropic Langmuir turbulence, excited by a relativistic electron beam and determined by processes of induced scattering on ions, were modeled by numerical methods. It was found that in the process of evolution the distribution of the wave with respect to the scattering angle becomes symmetrical with respect to $\pi/2$ but remains sharply anisotropic. The latter effect was illustrated by graphs of the behavior with time of the function of anisotropy. The possibility of nonlinear stabilization of the instability was illustrated. (tr-auth)

7957 (MATT—1177) **Two new proofs of the test particle superposition principle of plasma kinetic theory.** Krommes, J.A. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). Dec 1975. Contract E(11-1)-3073. 28p. Dep. NTIS $4.00.

The test particle superposition principle of plasma kinetic theory is discussed in relation to the recent theory of two-time fluctuations in plasma given by Williams and Oberman. Both a new deductive and a new inductive proof of the principle are presented. The fundamental observation is that two-time expectations of one-body operators are determined completely in terms of the (x,v) phase space density autocorrelation, which to lowest order in the discreteness parameter obeys the linearized Vlasov equation with singular initial condition. For the deductive proof, this equation is solved formally using time-ordered operators, and the solution then rearranged into the superposition principle. The inductive proof is simpler than Rostoker's, although similar in some ways; it differs in that first order equations for pair correlation functions need not be invoked. It is pointed out that the superposition principle is also applicable to the short-time theory of neutral fluids. (auth)

7958 (UCID—16973) **Radiationally-induced radial contraction of Z-pinches.** Shearer, J.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Nov 1975. Contract W-7405-Eng-48. 32p. Dep. NTIS $5.00.

A one-dimensional calculation of the radial motion of a Z-pinch was based on the Bennett relation, ohmic heating, and radiation loss. The result shows that the pinch will shrink if its current exceeds the Pease—Braginskii current (.1—1.5 megamps, depending on the radial density distribution and the impurity level), and if the shrinkage rate exceeds the growth rate of instabilities. It is suggested that the approximately 0.1 mm x-ray sources observed in plasma focus experiments are produced by this mechanism. (auth)

7959 (UCRL—77047) **Interaction of relativistic electron beams with high Z plasmas.** Kershaw, D.S. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 27 Oct 1975. 14p. (CONF-751130—11). Dep. NTIS $4.50.

From APS meeting; St. Petersburg, Florida, USA (10 Nov 1975).

A set of relativistic multigroup diffusion equations was derived for the study of electron beam—target interactions. Included are transport, Coulomb collisions, electric and magnetic fields, bremsstrahlung, and hydrodynamic motion of the background plasma. LASNEX, the Laser-Fusion code, is being modified to include these equations and will be used for modeling electron beam fusion. (auth)

7960 (UCRL—77149) **Energy flux limitation by tame turbulence.** Manheimer, W.M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Nov 1975. Contract W-7405-Eng-48. 19p. (CONF-751130—7). Dep. NTIS $4.50.

From APS meeting; St. Petersburg, Florida, USA (10 Nov 1975).

A quasi-linear theory of energy flux limitation by ion acoustic turbulence is presented. This distribution function is modelled by a Maxwellian plus an additional piece which carries a heat flux Q. By taking the fourth moment of the Vlasov equation one finds the anomalous thermal conductivity K approximately 3 v/sub e/ delta/sub De/ (e phi/T/sub e/)$^{-2}$. Other moments treated self-consistently include anomalous ion heating, electron cooling, current generation and enhanced inverse bremsstrahlung due to the nonthermal ion fluctuations. (auth)

7961 (UCRL—77168) **Nonthermal effects in two component DT fusion reactors.** Weaver, T.A.; Chu, T.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 7 Nov 1975. 12p. (CONF-751130—16). Dep. NTIS $3.50.

From APS meeting; St. Petersburg, Florida, USA (10 Nov 1975).

Net energy generation rates and f-factors are calculated for a variety of two component DT reactor configurations using a computer code that follows the energy distributions of the reactants and products explicitly, utilizing the Fokker—Planck approximation for low-angle Coulomb scattering and a transfer matrix for high-angle Coulomb, nuclear, and radiative processes. The relative importance of such non-thermal effects as alpha particle deposition, non-Maxwellian energy distributions for the target tritons and electrons, and the influence of high-angle Coulomb and nuclear scattering on the energy loss rate of the injected deuterons is explicitly assessed. (auth)

7962 **Non-axisymmetric toroidal transport and plasma rotation.** Tsang, K.T. Princeton, NJ; Princeton Univ. (1974). 139p. University Microfilms Order No. 75-23,247.

Thesis (Ph. D.).

An expression was calculated for parallel ion flow in general nonaxisymmetric geometry, both in fluid and banana regime. Ambipolar conditions in these regimes are obtained from the ion flux. A relaxation which is quite different from the classical viscosity effect is thus derived. This relaxation however resembles the coupling between the radial temperature gradient and the relaxation of parallel ion flow obtained by Rosenbluth et al., in banana regime of an axisymmetric system. When the nonaxisymmetry becomes smaller and smaller, the relaxation of parallel ion velocity then comes from the quasi-neutrality requirement on the higher order fluxes. The nonaxisymmetric effect is mixed with the axisymmetric effect. As a basis of the calculation, the axisymmetric calculation of Rosenbluth et al., for banana regime is extended to intermediate and fluid regime. A small perturbation to this axisymmetric result is obtained by including a higher order non-ambipolar flux in the calculation. Final result shows that an exponential type relaxation term should be added to the axisymmetric equation if there are small ripples on the tokamak field. This term may be significant for a large machine such as PLT. (Diss. Abstr. Int., B)

7963 **Adiabatic evolution of plasma equilibrium.** Grad, H.; Hu, P.N.; Stevens, D.C. (New York Univ., NY). *Proc. Natl. Acad. Sci. U.S.A.*; **72**: No. 10, 3789-3793(Oct 1975).

A new theory of plasma equilibrium is introduced in which adiabatic constraints are specified. This leads to a mathematically nonstandard structure, as compared to the usual equilibrium theory, in which prescription of pressure and current profiles leads to an elliptic partial differential equation. Topologically complex configurations require further generalization of the concept of adiabaticity to allow irreversible mixing of plasma and magnetic flux among islands. Matching conditions across a boundary layer at the separatrix are obtained from appropriate conservation laws. Applications are made to configurations with planned islands (as in Doublet) and accidental islands (as in Tokamaks). Two-dimensional, axially symmetric, helically symmetric, and closed line equilibria are included. (auth)

7964 **Vacuum arc anode plasma. II. Collisional-radiative model and comparison with experiment.** Bacon, F.M.; Watts, H.A. (Sandia Laboratories, Albuquerque, New Mexico 87115). *J. Appl. Phys.*; **46**: No. 11, 4758-4766(Nov 1975).

A one-dimensional model describing the ionization and excitation of Al^{2+} ions in the anode plasma of a vacuum arc is developed using collisional-radiative ionization and recombination coefficients. The model is constructed so that local thermodynamic equilibrium (LTE) is approached in the collision-dominated limit; however, when the results of the model are compared with the experimental data, the anode plasma is shown not to be in LTE. The experimental and theoretical results are shown to be consistent for N/sube/≅5times10^{20} m^{-3} and kT/sube//e≅30 V within about 0.3 mm of the anode surface. At distances greater than 0.3 mm from the anode, kT/sube//e<15 V. The change in T/sube/ at Z=0.3 mm suggests that a potential "hump" exists in the anode plasma out to Z=0.3 mm. Theoretical Al^{2+} excited-state densities are shown to be related by a Boltzmann factor with a "temperature" that is considerably less than and independent of the electron temperature in the plasma. (AIP)

PLASMA PRODUCTION

7965 (CONF-740642—, pp C4.1-C4.5) **Behavior of a bounded plasma inside a microwave cavity at high and low pressures.** Asmussen, J. Jr.; Hawley, M.C.; Mallavarpu, R.; Mertz, S. (Michigan State Univ., East Lansing). 1974.

From 2. topical conference on RF plasma heating; Lubbock, Texas, USA (20 Jun 1974).

In Proceedings of the second topical conference on RF plasma heating.

The design of a large-volume, versatile, efficient microwave plasma source is described. The source consists of a quartz tube surrounded by a cylindrical, variable-length cavity which is connected to a microwave power source. The lossy plasma-cavity eigenfrequencies are computed as functions of plasma density, effective collision frequency and cavity length. The circuit performance of the plasma-cavity system is qualitatively explained based on these eigenfrequency calculations. Experimental results demonstrate that a variable, high-density plasma with densities in excess of 1000 critical densities can be sustained. By adjusting cavity length and coupling, microwave plasmas can be sustained in flowing and nonflowing argon gaseous environments from pressures of several microns to over one atmosphere. Applications of this plasma source in two areas are described: (1) plasma chemistry experiments and (2) parametric instabilities under the influence of strong rf electric fields. (auth)

PLASMA INSTABILITIES

7966 (CONF-740642—, pp D4.1-D4.6) **Parametric instability induced in a multispecies plasma by magnetosonic waves.** Sperling, J.L.; Perkins, F.W. (Princeton Univ., NJ). 1974.

From 2. topical conference on RF plasma heating; Lubbock, Texas, USA (20 Jun 1974).

In Proceedings of the second topical conference on RF plasma heating.

Magnetosonic waves propagating near an ion gyrofrequency or the sum of the ion gyrofrequencies of a multispecies plasma can excite parametric instabilities due to relative ion motion. Although both the decay and purely growing instabilities may be excited, the decay instability into two electrostatic ion cyclotron waves with k/sub perpendicular/rho/sub i/ much greater than 1 leads to the lowest thresholds. The effect of density gradients and inhomogeneous magnetic fields on the threshold is discussed. (auth)

7967 (CONF-740642—, pp D7.1-D7.6) **Saturation of the parametric ion acoustic decay instability in isothermal plasmas.** Flick, J.T.; Hendel, H.W. (Princeton Univ., NJ). 1974.

From 2. topical conference on RF plasma heating; Lubbock, Texas, USA (20 Jun 1974).

In Proceedings of the second topical conference on RF plasma heating.

Saturation measurements are reported on the isothermal parametric ion acoustic decay instability, driven by a coherent pump field (ω_0 approximately ω/sub pe/). Saturation E^2/sub inst/ approximately E_0^2 occurs without significant changes in instability spectra and wavelengths (no cascading), in agreement with a theory that includes the effect of nonlinear interactions between comparable pump and instability field intensities. The significance of this result with regard to instability-generated anomalous resistivity and pump depletion effects is discussed. (auth)

7968 (LA—6044-PR, pp 31-41) **Feedback stabilization of scyllac.** Call, D.L.; Kutac, K.J.; Miller, G.; Quinn, W.E. Aug 1975.

In LASL Controlled Thermonuclear Research Program. Progress report, January—December 1974.

The MHD feedback stabilization theory for the Scyllac device is reviewed. The theory covers scaling, feedback parameters, frequency response analysis, and equations of motion. (MOW)

7969 (LA—6044-PR, pp 122-144) **Theoretical physics program.** Riesenfeld, W.B.; Baker, D.A.; Barnes, D. Aug 1975.

In LASL Controlled Thermonuclear Research Program. Progress report, January—December 1974.

During the reporting year the LASL CTR theory group has continued to increase its efforts in the field of magnetohydrodynamics (MHD) theory as applied to the equilibrium and stability of complex toroidal confinement systems such as Scyllac and high-beta tokamaks. The second field which has seen concentrated efforts is the area of Vlasov analysis and numerical computation. Much work was done to map out and analyze high-beta electromagnetic microinstabilities acting in theta and Z-pinch implosion sheaths, and to refine several formulations of the so-called hybrid plasma model in which the ions are treated kinetically through the Vlasov equations while the electrons are considered to form a charge neutralizing MHD or drift fluid. In a third area of work, the numerical Computer Applications program has made significant contributions to the experimental programs by modeling the dynamics of Z-pinches and theta pinches using various physical models for the plasma. Finally, considerable effort has been expended on scaling studies of the feedback, wall stabilization, and staging requirements of Scyllac-like confinement systems. (MOW)

7970 (MATT—1182) **Ion-beam-driven resonant ion cyclotron instability.** Hendel, H.W.; Yamada, M.; Seiler, S.W.; Ikezi, H. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). Nov 1975. Contract E(11-1)-3073. 10p. Dep. NTIS $4.00.

The resonant ion-beam-driven electrostatic ion cyclotron instability is identified. Measured dispersion relation and onset vs. beam energy and density agree with numerical calculations based on a theory which includes beam acoustic terms. After amplitude saturation, velocity space diffusion of the beam ions is observed. (auth)

7971 (ORNL-tr—4030) **Development of a helical MHD instability.** Gerlakh, N.I.; Sueva, N.M.; Morozov, A.I.; Solov'ev, L.S. (AN SSSR, Moscow). 1975. Translated by M. Gerrard from Preprint No. 74. 22p. Dep. NTIS $4.50.

The development of a helical instability, in time, in a plasma torus is examined by means of a numerical solution of the equations of ideal magnetohydrodynamics with a fixed plasma boundary. It is shown that for plasma with a high conductivity this process leads to formation of a filamentous structure of the magnetic surface. (auth)

PLASMA WAVE PHENOMENA

7972 **Limitation of Brillouin scattering in plasmas.** Kruer, W.L.; Valeo, E.J.; Estabrook, K.G. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). *Phys. Rev. Lett.*; **35**: No. 16, 1076-1079(20 Oct 1975).

It is shown that Brillouin scattering of intense laser light in plasmas can be limited by momentum and energy deposition as a result of reflection of the light. The calculations compare favorably with some recent experimental results. (AIP)

7973 (CONF-740642—, pp A1.1-A1.9) **Eigenmode structure in bounded inhomogeneous plasma slab near ion cyclotron frequency.** Adam, J.; Takahashi, H. (Princeton Univ., NJ). 1974.

From 2. topical conference on RF plasma heating; Lubbock, Texas, USA (20 Jun 1974).

In Proceedings of the second topical conference on RF plasma heating.

The wave field distribution in a parallel-plate waveguide filled with plasma has been investigated near the ion cyclotron frequency by numerical integration of the full cold plasma equations taking electron inertia into account. The static magnetic field is parallel to the waveguide axis and its intensity varies across the waveguide cross-section. The density profile is taken to be parabolic. Contrary to the predictions of the theory neglecting electron inertia, discrete eigenmodes are found regardless of the presence of the so-called "perpendicular resonance layer" within the plasma. In contrast to homogeneous plasmas, the short-wavelength electrostatic branch of the slow wave solutions is important in inhomogeneous plasmas and the eigenmode structure of the two cases are considerably different from each other. (auth)

7974 (CONF-740642—, pp B2.1-B2.6) **Numerical solution for linear wave conversion near lower hybrid resonance.** Simonutti, M.D.; Parker, R.R. (Massachusetts Inst. of Tech., Cambridge). 1974.

From 2. topical conference on RF plasma heating; Lubbock, Texas, USA (20 Jun 1974).

In Proceedings of the second topical conference on RF plasma heating.

Linear mode conversion near lower hybrid resonance in an inhomogeneous plasma is studied in the theory of the moment equations with finite T/sub e/ and T/sub i/, without collisions, and in the electrostatic approximation. A first order linear system based on a self-consistent zero order solution to these equations is derived along with a complex small signal conservation theorem. A numerical solution is obtained yielding, along with the well known result of complete mode conversion, the spatial dependence of each variable in the conversion region. A spectrum of these single k/sub z/ wave solutions is synthesized to form the resonance cone response. (auth)

7975 (CONF-740642—, pp B8.1-B8.6) **Collisional effects on anti-resonant mode conversion in an inhomogeneous magnetoplasma.** Tang, T.; Wong, K.C. (Univ. of Massachusetts, Amherst). 1974.

From 2. topical conference on RF plasma heating; Lubbock, Texas, USA (20 Jun 1974).

In Proceedings of the second topical conference on RF plasma heating.

The effects of small collisional damping on the mode conversion of an extraordinary wave incident upon a warm magnetoplasma slab are studied. When a converted Bernstein mode is at anti-resonance, the absorption coefficient can be as high as 0.5 at very low collision frequencies. (auth)

7976 (CONF-740642—, pp C2.1-C2.6) **Experimental investigations of a helical antenna for exciting Alfven waves.** Knox, S.O.; Paoloni, F.J.; Kristiansen, M.; Hagler, M.O. (Texas Tech Univ., Lubbock). 1974.

From 2. topical conference on RF plasma heating; Lubbock, Texas, USA (20 Jun 1974).

In Proceedings of the second topical conference on RF plasma heating.

A new coupler for exciting Alfven waves was experimentally investigated. The coupler, which consists of four symmetric helical straps wound around the vacuum vessel, is driven by a four-phase rf source. It has been determined that this coupler excites waves that vary azimuthally as e/sup jm theta/, where m = +-1. The coupler exhibits a strong propagation directionality and is capable of launching waves whose wavelength differs considerably from its own. (auth)

7977 **Identification and saturation of the isothermal parametric ion acoustic decay instability.** Flick, J.T. Princeton, NJ; Princeton Univ. (1974). 99p. University Microfilms Order No. 75-23,199.

Thesis (Ph. D.).

This work is an experimental and theoretical analysis of the isothermal ion acoustic decay instability, excited by an intense RF field near the electron plasma frequency. Identification of this instability, where acoustic waves are severely ion Landau damped, is achieved primarily by measurements of wavelength and frequency, and its threshold and acoustic frequency dependence upon density. Properties of the unstable steady-state are also studied, showing that saturation, (E^2/sub inst/) α E_0^2, occurs without significant changes in instability spectra and wavelengths (no cascading). A theoretical saturation model that includes the effect of parametric action of large-amplitude decay waves back on the pump (in addition to the linear parametric instability equations) is presented. The predictions of this model are shown to be in agreement with observations of the saturated state. (Diss. Abstr. Int., B)

7978 **Classical induced scattering of coherent waves.** Johnston, R.S. Princeton, NJ; Princeton Univ. (1974). 252p. University Microfilms Order No. 75-23,213.

Thesis (Ph. D.).

Contributions are made to the classical theory of induced scattering in plasma. The presentation is in two parts. Particle trapping in the beat potential produced by the mixing of two coherent waves lies outside the domain of the conventional weak-turbulence theory of induced scattering. In part one, a canonical reformulation of the theory is presented which is applicable to this extended domain. A review of the literature on the subject of induced scattering is presented at the outset. Both the quantum mechanical regime and the classical limit are considered, with an extensive and current bibliography. Then the motivation for an extension of the conventional theory is discussed, with reference to specific laboratory and astrophysical applications. The reformulation presented is based upon a canonical transformation to oscillation-center variables. The potential value of such dressed-particle transformations is assessed in the more general context of plasma kinetic theory, and speculations are made concerning a reformulation of strong-turbulence theory. In part two, plasma effects are suppressed and attention is focussed on the resonant interaction between a single relativistic charge and two coherent electromagnetic waves. The simplification in context is exploited to elucidate several aspects of the nonlinear theory of induced scattering. (Diss. Abstr. Int., B)

THERMONUCLEAR POWER PLANTS

7979 (BNL—19947) **Analysis of steady-state and pulsed operating regimes for controlled thermonuclear reactors with very large power ratings.** Usher, J.L.; Powell, J.R. (Brookhaven National Lab., Upton, N.Y. (USA)). Mar 1975. 121p. Dep. NTIS $6.50.

The operating regimes of large CTR's are identified and examined for cases of steady-state and pulsed operation. Several technological benefits of these large reactors are determined: (1) low maximum magnetic field strength requirements (25 to 50 percent less than for 5000 MW(th) reactors), (2) high n tau products (10^{15} to 10^{17} sec/cm^3) with associated high burn-up fractions (10 to 50 percent), (3) relatively little problem with impurity build-up, and (4) long confinement times (50 to 500 seconds). The advantages of pulsed operation are also discussed: (1) smaller problem with impurities than in the steady-state case, (2) alleviation of any possible fueling difficulties, and (3) no problem with control of temperature in the pulsed reactor based on a simple control function model incorporating a finite delay time. (auth)

7980 (CONF-751125—93) **Assembly of the PLT device.** Marino, R. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). Nov 1975. 2p. Dep. NTIS $3.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

The assembly of the PLT device began in June 1974 with a preassembly of the mechanical structure at a remote site. The preassembly sequence incorporated final fabrication procedures with an initial staging operation. This successful staging/fabrication procedure proved to be an invaluable asset when the final assembly was started in August 1974. The assembly continued with the initial reassembly of the previously tested structural components at the final machine site. Construction was interrupted at several points to allow for toroidal field coil, vacuum vessel, and poloidal coil installation. Two phases of toroidal field coil power tests were included in the assembly sequence prior to, and just after the vacuum vessel insertion. (auth)

7981 (GA-A—13688) **Design of doublet III.** Hubbard, E.L.; Gilleland, J.R.; Jensen, T.H.; Schupp, A.A.; Wesley, J.C. (General Atomic Co., San Diego, Calif. (USA)). 19 Sep 1975. Contract E(04-3)-167. 17p. (CONF-751125—113). Dep. NTIS $3.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

A cutaway drawing of Doublet III is given. The major radius is 1.43 m. The toroidal vacuum chamber has a rectangular cross section with a width of 0.9 m and a height of 3.0 m. The walls of the vacuum chamber are made of an Inconel corrugated sheet structure which is thin enough that a circumferential insulating break is not necessary. The set of field-shaping coils is located just outside the vacuum chamber. Design parameters for the system are given. (MOW)

7982 (LA—6044-PR) **LASL Controlled Thermonuclear Research Program. Progress report, January—December 1974.** Ribe, F.L. (comp.). (Los Alamos Scientific Lab., N.Mex. (USA)). Aug 1975. Contract W-7405-ENG-36. 236p. Dep. NTIS $7.60.

Separate abstracts were prepared for the fourteen included sections. (MOW)

7983 (LA—6044-PR, pp 3-30) **Scyllac full torus experiments.** Cantrell, E.L.; Ellis, W.R.; Freeman, B.L. Aug 1975.

In LASL Controlled Thermonuclear Research Program. Progress report, January—December 1974.

A review is given of the Scyllac experiment to study methods of producing stable high-beta plasma equilibrium and confinement in a high-beta, stellarator toroidal geometry. Magnetic field measurements are briefly discussed. Some diagnostic apparatus and measurement results are described. (MOW)

7984 (LA—6044-PR, pp 54-58) **Scylla IV-P theta pinch.** Quinn, W.E.; Bailey, A.G.; Chandler, G.I.; Hansborough, L.D.; Lillberg, J.W.; Machalek, M.D.; Seibel, F.T. Aug 1975.

In LASL Controlled Thermonuclear Research Program. Progress report, January—December 1974.

The Scylla IV-P is a flexible, linear experiment to support the toroidal Scyllac experiments and to investigate high-density, linear theta-pinch concepts. The experimental arrangement and construction status are described. (MOW)

7985 (LA—6044-PR, pp 58-80) **Scylla I-B/C.** McKenna, K.F., Freese, K.B.; Jahoda, F.C.; York, T.M.; Zimmermann, E.L. Aug 1975.

In LASL Controlled Thermonuclear Research Program. Progress report, January—December 1974.

The object of the Scylla I-B implosion heating experiment is to study the implosion process over a range of E/sub theta/'s and initial fill densities characteristic of past and present Scylla-type theta pinches. Ionization and implosion processes are discussed. Some plasma measurements on Scylla I-C are also reported. (MOW)

7986 (LA—6044-PR, pp 167-212) **Fusion technology.** Krakowski, R.A.; Booth, L.; Bosler, G.E. Aug 1975.

In LASL Controlled Thermonuclear Research Program. Progress report, January—December 1974.

The Fusion Technology task assesses the long-range technological requirements of fusion power derived from high-β confinement concepts. The effort includes theoretical analyses and plasma engineering, neutronic studies, nuclear data assessment, electrical insulator and structural alloy research, and general engineering; progress within each of these areas is summarized herein. On the basis of a conceptual engineering design of a Reference Theta Pinch Reactor (RTPR) an environmental impact study has been completed and a technological assessment is near completion. The Fusion Technology task has also supported engineering design activities for the Scyllac Fusion Test Reactor in the areas of tritium handling, radiation shielding, materials, vacuum technology and environmental/safety analyses. Preliminary design studies of a Linear Theta-Pinch Hybrid Reactor (LTPHR) have commenced, and more detailed design studies of this fission/fusion concept are proceeding. (auth)

7987 (LA—6044-PR, pp 213-221) **Scyllac fusion test reactor design.** Dudziak, D.J.; Gerstl, S.A.; Houck, D.L.; Jalbert, R.A.; Krakowski, R.A.; Linford, R.K.; McDonald, T.E.; Rogers, J.D.; Thomassen, K.I. Aug 1975.

In LASL Controlled Thermonuclear Research Program. Progress report, January—December 1974.

A general design of the system is given. The implosion heating and compression systems (METS) are described. Tritium handling, shielding and activation of the reactor, and safety and environmental aspects are discussed. (MOW)

7988 (LA—6173-MS) **Design of the ZT-1 toroidal pinch experiment.** Baker, D.A.; Burkhardt, L.C.; Dike, R.S.; Di Marco, J.N.; Forman, P.R.; Haberstich, A.; Karr, H.J.; Mann, L.W.; Phillips, J.A.; Schofield, A.E. (Los Alamos Scientific Lab., N.Mex. (USA)). Dec 1975. Contract W-7405-ENG-36. 19p. Dep. NTIS $4.50.

Electrical design details are given for a toroidal Z-pinch device named ZT-1 that uses field programming to achieve a stable, reversed field pinch. The plasma is formed in a 4-mm-thick, 10.3-cm-i.d., high alumina, segmented ceramic vacuum chamber. Voltages as high as 70 kV are routinely attained by interrupting with a fuse 800 kA in an inductive store. The current is diverted from the fuse to the primary of a single-turn transformer divided into quadrants. A total of 280 kV at 200 kA can then be applied to the plasma, which forms the secondary circuit of the transformer. This system produces dB/sub theta//dt's of up to 8 T/μs; with modifications to the electrical system, dB/sub theta//dt's as low as 0.1 T/μs are obtained. The B/sub z/ bias field of up to 0.25 T can be reversed at a rate of up to 0.2 T/μs. Both B/sub theta/ and B/sub z/ magnetic field errors are minimized. The design of the fuses and magnetic core and the development of a low inductance and resistance metal-to-metal crowbar are described. (auth)

7989 (LA—6178-MS) **Origin of axial current in scyllac.** Sugisaki, K. (Los Alamos Scientific Lab., N.Mex. (USA)). Dec 1975. Contract W-7405-ENG-36. 4p. Dep. NTIS $4.50.

The origin of the axial current observed in Scyllac (a high beta stellarator experiment) is discussed. A shaped coil and/or helical winding produce rotational transform which links magnetic lines of force to the plasma column and the axial current is induced electromagnetically. This phenomenon is inherent in a pulsed high-beta stellarator. The rotational transform produced by the induced axial current is much smaller than that associated with the $l = 1$, 0 equilibrium fields. The effect of the axial current on the equilibrium and stability of the plasma column is thus small. It is also shown that the magnetic field shear near a plasma surface is very strong. (auth)

7990 (LA-UR—75-2283) **Scylla IV-P linear theta pinch, a design and construction overlook.** Bailey, A.G.; Machalek, M.D. (Los Alamos Scientific Lab., N.Mex. (USA)). 1975. Contract W-7405-ENG-36. 5p. (CONF-751125—88). Dep. NTIS $3.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

The Scylla IV-P theta-pinch device has been designed as a flexible, linear experiment to investigate linear theta-pinch concepts. It is a conventional theta pinch using Scyllac components to

energize a 5-m coil. Six hundred 60-kV, 1.85-μF capacitors are used to provide 2 MJ of energy storage which will give a maximum crowbarred field of 55 kG in a smooth 11.2-cm bore coil. The risetime is approximately 3 μs. A 4.5-kJ preionization bank ringing at 0.4 MHz is incorporated. All machine operations are under computer control, using a Prime 300 computer. The computer, the control console, and the diagnostic readouts are located in a screen room immediately adjacent to the machine. The machine was laid out in a 10-capacitor module to facilitate maintenance and make maximum use of the available volume. (auth)

7991 (ORNL-TM—5109) **Program for development of toroidal superconducting magnets for fusion research, May 1975.** Long, H.M.; Lubell, M.S. (eds.). (Oak Ridge National Lab., Tenn. (USA)). Nov 1975. Contract W-7405-eng-26. 142p. Dep. NTIS $7.60.

The objective of this program is a tested magnet design which demonstrates the suitability and reliability needed to qualify toroidal superconducting magnets for fusion research devices in a time compatible with the D-T burning experiments time frame. The overall applied development program including tasks, manpower, and cost estimates is detailed here, but for the full toroidal system only the cost and time frame are outlined to show compatibility with the present program. The details of the full toroidal system fall under major device fabrication and will be included in a subsequent document. (auth)

7992 (UCRL—77465) **Controlled fusion physics: experimental.** Post, R.F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 23 Oct 1975. 14p. (CONF-751130—4). Dep. NTIS $4.50.

From APS meeting; St. Petersburg, Florida, USA (10 Nov 1975).

A historical review is given of the experimental thermonuclear research program. The role of pinch devices, mirror machines, tokamak devices, and laser fusion is discussed. (MOW)

7993 (UCRL-Trans—10940) **Fusion reactors as a future energy source.** Seifritz, W. Translated from *Schweiz. Ver. Atomenerg., Bull.*; No. 10, vp(1975). 60p. Dep. NTIS $6.00.

A detailed update of fusion research concepts is given. Discussions are given for the following areas: (1) the magnetic confinement principle, (2) UWMAK I: conceptual design for a fusion reactor, (3) the inertial confinement principle, (4) the laser fusion power plant, (5) electron-induced fusion, (6) the long-term development potential of fusion reactors, (7) the symbiosis between fusion and fission reactors, (8) fuel supply for fusion reactors, (9) safety and environmental impact, and (10) accidents, and (11) waste removal and storage. (MOW)

7994 **Technology and economics of hydrogen production from fusion reactors.** Powell, J.; Salzano, F.J.; Sevian, W.A. (Brookhaven National Lab., Upton, NY). pp 255-277 of In Hydrogen energy. Part A. Veziroglu, T.N. (ed.). New York; Plenum Publishing Corp. (1975).

From Hydrogen economy Miami energy conference; Miami Beach, Florida, USA (18 Mar 1974).

See CONF-740306—PA.

The technology, economics, and environmental effects of producing synthetic fuels (H_2 gas, H_2 liquid, and methanol) based on fusion (CTR) reactors are assessed. Four United States energy systems (2020 A.D.) with different degrees of CTR implementation are compared: in System A, no CTR input is assumed; in System B, CTRs replace 50 percent of nuclear fission electric; in System C, CTRs supply all electrical demand, produce synthetic fuels to replace all oil and gas imports, and eliminate strip mining; and in System D, CTRs supply all electrical demand and virtually all fuel demand. CTR reactor costs are analyzed in detail for a range of containment parameters, reactor outputs, and first well loadings for DT and catalyzed DD fuel cycles. (auth)

PHYSICS AND BLANKET ENGINEERING

7995 (BNL—20713) **Thermal design and analysis of steady state graphite blankets.** Fillo, J.A.; Powell, J.R. (Brookhaven National Lab., Upton, N.Y. (USA)). 1975. Contract E(30-1)-16. 16p. Dep. NTIS $4.50.

A description is given of the graphite blanket design for either an experimental power reactor or commercial reactor. A thermal analysis was made of the blanket. It is shown that the introduction of a low conductivity surface layer permits one to go to higher first wall loadings for commercial reactors. (MOW)

7996 (BNL—20760) **Calculational model and data for CTR neutronics and photonics.** Maynard, C. (Brookhaven National Lab., Upton, N.Y. (USA)). Sep 1974. Contract E(30-1)-16. 18p. Dep. NTIS $4.50.

The following topics are discussed: (1) results required for CTR design and analysis, (2) calculational methods and computer programs exclusive of data, and (3) nuclear data and its processing. (MOW)

7997 (CONF-751125—75) **Design of an EPR blanket.** Bettis, E.S.; Huxford, T.J.; McAlees, D.G.; Santoro, R.T.; Watts, H.L.; Williams, M.L. (Union Carbide Corp., Oak Ridge, Tenn. (USA). Nuclear Div.). 1975. 13p. Dep. NTIS $4.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

A blanket concept is presented which meets typical requirements anticipated for an Experimental Power Reactor. Design alternatives are reviewed. One-dimensional neutronic and thermal hydraulic results are presented for the ORNL reference design. Design consideration was given for remote maintenance and assembly requirements. Modifications of the reference design first wall are necessary because of high thermal stresses. (auth)

7998 (LA—6044-PR, pp 145-157) **CTR engineering.** Kemp, E.L.; Banta, J.J.; Barnes, G.A. Aug 1975.

In LASL Controlled Thermonuclear Research Program. Progress report, January—December 1974.

The power supplies for full torus operation are described. Some capacitor gap failures are discussed. The feedback stabilization system is mentioned. Some power supply problems for Scylla IV-P, toroidal z pinch, and the Scyllac fusion test reactor are described. (MOW)

7999 **White-light interferometric measurement of the wall thickness of hollow glass microspheres.** Weinstein, B.W. (University of California, Lawrence Livermore Laboratory, Livermore, California 94550). *J. Appl. Phys.*; **46**: No. 12, 5305-5306(Dec 1975).

A simple interferometric technique using both a white-light and a monochromatic-light source can be used to measure the wall thickness of hollow glass microspheres to better than 0.05 μm. The entire procedure requires only a few minutes per sphere and can easily be made to take into account the effects of any gas with which the ball is filled. (AIP)

MAGNET COILS AND FIELDS

8000 (ANL/HEP-CP—75-69) **Superconducting equilibrium coil desgin studies for the Argonne Experimental Power Reactor.** Wang, S.T.; Purcell, J.R.; Turner, L.R. (Argonne National Lab., Ill. (USA)). Nov 1975. Contract W-31-109-Eng-38. 7p. (CONF-751125—76). Dep. NTIS $4.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

As an integral effort in the Argonne Experimental Power Reactor design studies, a scoping-study was made on the equilibrium coil system. Various design options were investigated. The reference design is a superconducting equilibrium field coil system located outside the toroidal field coils for reasons of ease of coil assembly, disassembly, coil support, remote maintenance and the least interference with the assembly and disassembly of the first wall and the blanket and shield. It was also found that there is a large I^2R loss if the coils were made of water-cooled copper. The superconducting equilibrium coil design was developed in considerable detail with the 60,000 A ac superconducting low loss cable design, ac pulsing loss evaluation and the full stabilization examination. The proposed superconductor is NbTi with copper and cupro-nickel as two-component matrix. Finally, the equilibrium field requirements are also discussed. (auth)

8001 (ANL/HEP-CP—75-70) **Pure tension superconducting toroidal-field coil system design studies for the Argonne Experimental Power Reactor.** Wang, S.T.; Purcell, J.R.; Demichele, D.W.; Turner, L.R. (Argonne National Lab., Ill. (USA)). Nov 1975. Contract W-31-109-Eng-38. 6p. (CONF-751125—77). Dep. NTIS $4.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

As part of the Argonne Tokamak Experimental Power Reactor (TEPR) design studies, a toroidal field (TF) coil system has been designed. NbTi was chosen as the most suitable superconductor and 8T was regarded as a practical peak field level in this study. The 16-coil design was chosen as a reasonable compromise between 2 percent field ripple and 3 m access gap. To minimize the coil structure and the bending moments on the conductor, a pure tension coil shape is necessary. A correct approach for determining the pure tension coil profile in a bumpy TF coil system is given. Verification of the pure tension coil by a three-dimensional stress analysis is presented. For coil quench protection, a series-connected scheme is proposed. (auth)

8002 (CONF-751125—74) **Superconducting coil protection.** Woods, E.L. (Oak Ridge National Lab., Tenn. (USA)). 1975. 6p. Dep. NTIS $4.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

The protection system is based on a two-phase construction program. Phase I is the development of a reliable hardwired relay control system with a digital loop utilizing firmware and a microprocessor controller. Phase II is an expansion of the digital loop to include many heretofore unmonitored coil variables. These new monitored variables will be utilized to establish early quench detection and to formulate confirmation techniques of the quench detection mechanism. Established quench detection methods are discussed and a new approach to quench detection is presented. The new circuit is insensitive to external pulsed magnetic fields and the associated induced voltages. Reliability aspects of the coil protection system are discussed with respect to shutdowns of superconducting coil systems. Redundance and digital system methods are presented as related topics. (auth)

8003 (CONF-751125—89) **Eccentric Coil Test Facility (ECTF).** Burn, P.B.; Walstrom, P.L.; Anderson, W.C.; Marguerat, E.F. (Union Carbide Corp., Oak Ridge, Tenn. (USA). Nuclear Div.). 1975. 8p. Dep. NTIS $3.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

The conceptual design of a facility for testing superconducting coils under some conditions peculiar to tokamak systems is given. A primary element of the proposed facility is a large 25 MJ background solenoid. Discussions of the mechanical structure, the stress distribution and the thermal stability for this coil are included. The systems for controlling the facility and diagnosing test coil behavior are also described. (auth)

8004 (CONF-751125—94) **PLT toroidal field coil power tests.** Marino, R.; Citrolo, J.; Frankenberg, J. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). Nov 1975. 2p. Dep. NTIS $3.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

The PLT toroidal field coil power tests were initiated in October, 1974 to gain information in several areas. The most important objectives during the tests were the verification of deflections and stresses as predicted by Frankenberg and Smith. Also, the stability of the toroidal field coils against radial self-field loading was to be determined. Lastly, the predicted thermal characteristics of the coils were to be verified. (auth)

8005 (CONF-751125—95) **Application data for the PLT stabilizing field rectifier.** Bronner, G.; Murray, J.G.; Oliaro, G.E. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). Nov 1975. 2p. Dep. NTIS $4.00.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

This paper describes the 12-pulse stabilizing field rectifier used for vertical field production in the Princeton Large Torus (PLT). It is essential that the rectifier be reliable, and protect itself from all faults including induced transient overvoltage produced by switching and plasma instabilities. To this end, computer simulations were run to insure protection under various fault conditions. (auth)

8006 (CONF-751125—96) **PDX machine poloidal field coils.** Heitzenroeder, P.J.; Dahlgren, F. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). Nov 1975. 6p. Dep. NTIS $3.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

This paper describes the PDX Poloidal Coils, their engineering designs, specifications, and fabrication methods. (auth)

8007 (CONF-751125—97) **Design and fabrication of the PDX poloidal field solenoid utilizing fiberglass reinforced epoxy.** Young, K.S.C. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). Nov 1975. 18p. Dep. NTIS $3.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

This paper discusses the basic design of the Poloidal Field Solenoid Coil. It will be mainly concerned with the more unique features of the Solenoid such as the copper coil windings and the design of the epoxy-glass structural support mandrels. The center solenoid coil of the PDX machine consists of five different coil systems (OH No. 8, No. 9; NF No. 11; DF No. 7; EF Solenoid and CF No. 9). Three concentric fiberglass reinforced epoxy cylinders fabricated in-house will act as mandrels to support and to house the coils that will result as an integral unit. (auth)

8008 (COO—2493-3) **Elastic stability and vibration of toroidal magnets for fusion reactors. Final report.** Moon, F.C.; Swanson, C. (Princeton Univ., N.J. (USA). Dept. of Aerospace and Mechanical Sciences). Sep 1975. Contract AT(11-1)-2493. 83p. Dep. NTIS $5.00.

The vibration and elastic stability of a set of discrete superconducting toroidal field magnets arranged to form a "bumpy" torus is examined. The mutual destabilizing magnetic forces between magnet pairs are calculated using a numerical differential inductance technique. It is shown that the mutual attractive magnetic forces can produce elastic buckling of the entire toroidal set. The vibration modes of the set are also found as functions of the coil current. The response of the set of magnets to an earthquake type motion of the toroidal base is calculated. The calculations have been incorporated in a computer code which accompanies the report. Measurements are made of the lateral stiffness of a flexible, planar, superconducting coil between two rigid coils in series. These tests show a dramatic decrease in the natural bending frequency with subsequent elastic instability or "buckling" at a critical value of the current in the coils. These observations support a magnetoelastic analysis which shows that proposed designs, of toroidal field coils for Tokamak fusion reactors, have insufficient lateral support for mechanical stability of the magnets. (auth)

8009 (GA-A—13673) **Electrical insulation problems related to the doublet III coils.** Franklin, L.H. (General Atomic Co., San Diego, Calif. (USA)). 1 Oct 1975. Contract E(04-3)-167. 16p. (CONF-751125—111). Dep. NTIS $3.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

The basic requirements of the magnet system for Doublet III are described. The discussion is broken into the following areas: (1) operating voltages and anticipated maximum transient voltages, (2) mechanical forces, (3) dimensional requirements, (4) coil geometry and position, (5) stored energy available, and (6) insulating requirements. (MOW)

8010 (GA-A—13686) **Selection of materials and joining processes for the doublet III toroidal field coil.** Jones, J.D.; Puhn, F.A. (General Atomic Co., San Diego, Calif. (USA)). 6 Oct 1975. Contract E(04-3)-167. 17p. (CONF-751125—114). Dep. NTIS $3.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

Fatigue tests were performed on candidate copper alloy materials. The tests were fully reversed push-pull loads, equal in tension and compression. The tests were made parallel with and perpendicular to the material grain at temperatures of 68 to 230°F. Fatigue testing was also performed on adhesive lap joints and on specimens simulating the riveted soft solder joints. All tests were fully reversed except for the riveted lap joint specimens which were alternated between no load and the indicated tensile load. (MOW)

8011 (GA-A—13689) **Doublet III anti-torque structure.** Davis, L.G.; Gordon, H.S.; Puhn, F.A. (General Atomic Co., San Diego, Calif. (USA)). 25 Sep 1975. Contract E(04-3)-167. 13p. (CONF-751125—109). Dep. NTIS $3.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

An anti-torque structure is described that meets all the design criteria and involves a minimum of structural redundancy, utilizes ordinary manufacturing techniques, and incorporates adjustability. (MOW)

8012 (MATT—1133) **Mechanical design of a 250 kilogauss solenoidal magnet.** Bonanos, P. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). Dec 1975. Contract E(11-1)-3073. 11p. (CONF-751125—108). Dep. NTIS $4.00.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

The mechanical design and construction of a 5 cm bore, 23 cm long solenoidal magnet operated at 250 kilogauss is described. The magnet provides confining field for a plasma heated by a CO_2 laser. Radial diagnostic ports with a clear aperture of 0.41 cm allow viewing access near the magnet midplane. The on-axis field homogeneity is within 5 percent over a central length of 12 cm. The magnet sustained 500 to 1000 pulses at the highest field levels before catastrophic failure. (auth)

8013 (TID—26937) **Program for development of high-field superconducting magnets for fusion research.** (California Univ., Livermore (USA). Lawrence Livermore Lab.). 18 Apr 1975. 87p. Dep. NTIS $7.75.

Three superconducting magnet programs at LLL are outlined. The first program, the one considered in greatest detail, is a developmental program in which LLL will work closely with super-

conductor manufacturers to develop multifilamentary Nb_3Sn superconductor suitable for use in large CTR magnets. The result of this program will be the fabrication of a rather large magnet (but one that is much smaller than future CTR magnets) and the determination of its performance limitations. In the second program, the developed multifilamentary Nb_3Sn superconductor will be used to construct the magnets for the Fusion Engineering Research Facility (FERF) machine. In this program, the bulk of the effort will be in magnet design and winding. The third program chronologically overlaps the first two programs. This program includes the fabrication and testing of the superconducting magnets for the MX machine although, as explained in the Technical Plan, only the cost of the development work is included in this document. At the present time, Nb—Ti superconductor is being considered. Apart from some initial conductor design work, the major effort will be in magnet design and winding. (auth)

8014 (UCRL—50031-75) **Superconducting magnet development program progress report, July 1974—June 1975.** Cornish, D.N.; Harvey, A.R.; Nelson, R.L.; Taylor, C.E.; Zbasnik, J.P. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 24 Oct 1975. Contract W-7405-Eng-48. 123p. Dep. NTIS $5.45.

During FY 1975, the superconducting magnet development program at the Lawrence Livermore Laboratory was primarily directed toward the development of multifilamentary Nb_3Sn conductor for large CTR machines. It was secondarily concerned with preliminary work for the MX experiment and with the acquisition of additional testing facilities. Among the significant achievements was the construction and operation of a 27-cm-bore coil to its short-sample limit of 7-T at the windings. The coil was wound with a 100-m length of 67,507-filament Nb_3Sn conductor. (auth)

POWER SUPPLIES AND CIRCUITRY

8015 (CONF-751125—67) **120 kA pulsed DC power system with computerized thyristor triggering.** Mosko, S.W.; Bates, D.D.; Bigelow, R.R.; Cottongim, E.K.; Pipes, E.W.; Sueker, K. (Oak Ridge National Lab., Tenn. (USA)). 1975. 17p. Dep. NTIS $4.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

A pulsed dc power system provides 120 kA excitation current for the ORMAK toroidal field coils. A drive potential of 1000 volts brings the coils up to full current in about 0.5 seconds. Constant current is maintained for 0.25 seconds, then approximately 20×10^6 joules of stored energy is dumped in a free-wheeling diode and resistance network. The power system contains 8 each, 30 kA, 500 V thyristor controlled dc power modules in a series/parallel combination. A control computer generates thyristor trigger pulses in a programmed sequence as required for the desired duty cycle. A feedback network including current sensing and computer software permits trigger timing adjustments as necessary for consaant current operation. (auth)

8016 (CONF-751125—98) **PLT neutral injection ignitron accelerating supply.** Ashcroft, D.L.; Murray, J.G.; Newman, R.A.; Peterson, F.L. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). Nov 1975. 4p. Dep. NTIS $3.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

A phase-controlled rectifier was designed for the accelerating supply on the PLT Neutral Beam Injection system at PPPL. The rectifier must furnish 70 amperes at up to 50 KV for 300 milliseconds, with a duty cycle of up to 10 percent. Protection of the injectors requires the supply to withstand repeated crowbarring. The rectifying element selected to satisfy these requirements was a commercially-available ignitron, installed in a supporting frame and using firing circuits and controls designed by PPPL. (auth)

8017 (GA-A—13666) **Toroidal and OHMIC heating power supplies Ifor doublet III.** Callis, R.W.; Varga, H.J.; Wesley, J.C. (General tomic Co., San Diego, Calif. (USA)). 22 Sep 1975. Contract E(04-3)-167. 16p. (CONF-751125—112). Dep. NTIS $3.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

The Doublet III magnet system consists of three coil power-supply systems. The toroidal field system is designed to produce a 26 kG field at the nominal plasma radius of 1.4 m. The Ohmic heating system provides the high peak voltage and power required to produce and heat the plasma. The field shaping coils shape and position the plasma for stable operation and confinement. These power supplies are described. (MOW)

8018 (GA-A—13667) **Doublet III power and energy storage system.** Varga, H.J.; Callis, R.W.; Hubbard, E.L. (General Atomic Co., San Diego, Calif. (USA)). 22 Sep 1975. Contract E(04-3)-167. 16p. (CONF-751125—110). Dep. NTIS $3.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

A diagram is given of the entire Doublet III power system and two sources with interlocked breakers are illustrated. The basic energy source is a 69 kV transmission line of the San Diego Gas and Electric Company. The motor generators for the magnet coils are described. (MOW)

8019 (LA—6044-PR, pp 158-166) **Magnetic energy transfer and storage (METS).** Williamson, K.D.; Bailey, A.; Blevins, D.J. Aug 1975.

In LASL Controlled Thermonuclear Research Program. Progress report, January—December 1974.

During the past year significant progress has been made toward the goal of providing superconducting magnetic energy storage for plasma compression in the next generation of THETA-pinch experiments. The METS energy storage system will provide the primary energy for the compression coils in Scyllac Fusion Test Reactor (SFTR) and the staging energy requirements for the Experimental Power Reactor (EPR) torus and DEMO plant. In addition, this work will have application to other CTR programs such as ohmic heating in tokamak experiments and possible power supplies for laser flash lamps in the laser fusion program. The current program is developing the necessary components to accomplish this and will culminate in a demonstration METS-SFTR coupled superconducting prototype system. (auth)

8020 (LA-UR—75-2150) **Some properties of castor oil affecting its performance as a capacitor impregnant and their significance to future impregnant research.** Boicourt, G.P. (Los Alamos Scientific Lab., N.Mex. (USA)). 1975. Contract W-7405-ENG-36. 7p. (CONF-751125—50). Dep. NTIS $4.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

For a considerable time castor oil and polychlorinated biphenyl (PCB) have been the principal impregnants used in energy-storage capacitors. Castor oil has proven to be better than PCB for pulsed applications. PCB's have come under attack as an environmental hazard, while castor oil is a vegetable product and its supply and quality are subject to fluctuation. These two facts make the development of new impregnants desirable. The properties of PCB as a capacitor impregnant are well known. This paper first compares a number of properties of castor oil and PCB's. A comparison is made between the lives of castor oil capacitors and comparable PCB energy-storage capacitors. Some of the physical and chemical properties of castor oil which make it a good pulse capacitor impregnant are examined. These properties can be used as a guide for future research on new pulse capacitor impregnants. (auth)

8021 (LA-UR—75-2151) **System design of the Los Alamos Scientific Laboratory's staged theta pinch.** Hammer, C.F.; Thomas, K.S.; Borkenhagen, W.H.; Dike, R.S.; Banta, J.J.; Gribble, R.F.; Linford, R.K. (Los Alamos Scientific Lab., N.Mex. (USA)). 1975. Contract W-7405-ENG-36. 8p. (CONF-751125—49). Dep. NTIS $4.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

The Los Alamos Scientific Laboratory's staged theta pinch (STP) is the most recent theta pinch to be constructed at Los Alamos. The intent of the experiment is to provide programmable magnetic fields so that the initial implosion heating and compression of the theta-pinch plasma can be accomplished by the use of separate capacitor banks. The STP is a 4.5-m-long linear theta pinch, the discharge tube diameter is 20 cm. The system consists of five separate and independent capacitor banks, a 75-kV preionization bank, two 125-kV pulse-forming banks, a 700-kJ, 50-kV staging bank, and a 75-kV staging crowbar bank. A description is given of the STP electrical system and the mechanical design. Some of the unique components and techniques developed so this experiment could be built are described. (auth)

8022 (LA-UR—75-2152) **Multichannel spark-gap technology for staged theta-pinch machines.** Borkenhagen, W.H.; Gribble, R.F.; Hansborough, L.D.; Linford, R.K.; Melton, J.G.; Nunnally, W.C. (Los Alamos Scientific Lab., N.Mex. (USA)). 1975. Contract W-7405-ENG-36. 5p. (CONF-751125—48). Dep. NTIS $4.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

Triggered multichannel switches operating at voltages up to 180 kV with inductances of 10 to 15 nH have been developed for the staged theta-pinch machines at LASL. These multichannel devices, depending upon their design, can switch up to 30 kJ per switch with peak currents up to 1 MA. The designs of the various spark-gap configurations are discussed from a mechanical and an electrical viewpoint. The switching modes including crowbar, high-voltage start, and high-voltage holdoff low-voltage start, as well as

the experimentally determined triggering characteristics, are also discussed. (auth)

8023 (LBL—4418) **Power supply for the LBL 40 keV neutral beam source.** Baker, W.R.; Fitzgerald, M.L.; Honey, V.J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1975. Contract W-7405-Eng-48. 6p. (CONF-751125—84). Dep. NTIS $4.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

A 20 keV, 50 Amp, 10 millisec pulse D^0 Neutral Beam Source at the Lawrence Berkeley Laboratory that serves as the prototype for 12 similar sources now in operation on the 2XIIB Mirror Machine at the Lawrence Livermore Laboratory has been recently upgraded to operate at 40 keV. The system of electronically regulated and controlled power supplies that drive the Source is described. (auth)

8024 (LBL—4425) **Conceptual design of a neutral-beam injection system for the TFTR.** Ehlers, K.W.; Berkner, K.H.; Cooper, W.S.; Hooper, E.B.; Pyle, R.V.; Stearns, J.W. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1975. Contract W-7405-Eng-48. 5p. (CONF-751125—86). Dep. NTIS $4.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

The neutral-beam injection requirements for heating and fueling the next generation of fusion reactor experiments far exceed those of present devices; the neutral-beam systems needed to meet these requirements will be large and complex. A conceptual design of a TFTR tokamak injection system to produce 120 keV deuterium-ion beams with a total power of about 80 MW is given. (auth)

8025 (LBL—4429) **Saturable reactor-controlled power supply system for TCT/TFTR neutral beam sources.** Baker, W.R.; Hopkins, D.B.; Dexter, W.L.; Kuenning, R.W.; Smith, B.J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1975. Contract W-7405-Eng-48. 5p. (CONF-751125—85). Dep. NTIS $4.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

Each neutral beam source requires one major power supply, the acceleration supply, and four auxiliary power supplies. The power supplies are designed to permit independent interruption of current to any source and crowbarring within 20 μsec, in the event of a source spark, while not disturbing the normal pulsing of all other adjacent sources. The sources are described. (MOW)

8026 (LBL—4431) **Design considerations and data for gas-insulated high voltage structures.** Hopkins, D.B. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1975. Contract W-7405-Eng-48. 5p. (CONF-751125—83). Dep. NTIS $4.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

This paper is intended to benefit the person faced with the occasional task of designing gas insulated high-voltage structures or spark gaps and who must decide upon the proper geometry, spacings, gas type, and pressure for reliable voltage-holding. An approach is presented along with a summary of how various factors affect voltage breakdown. The design procedures described apply to situations where the influence of nearby insulators is negligible. The accuracy of the data is estimated to be within 10 to 15 percent, a value usually attained in practice only when one follows the cautionary advice discussed in the paragraphs on materials preparation, gas properties, and conditioning. (auth)

FUEL SYSTEMS

8027 (BNL—20656) **Intense negative hydrogen ion source for neutral injection into tokamaks.** Prelec, K.; Sluyters, T. (Brookhaven National Lab., Upton, N.Y. (USA)). 1975. 5p. (CONF-751125—87). Dep. NTIS $4.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

In this scheme negative ions are extracted from a plasma source, accelerated to the required energy and then neutralized by stripping in a gas, metal vapor or plasma jet. One of the most promising direct extraction sources is the magnetron source, operating in the mixed hydrogen-cesium mode. In the present source cathode current densities are up to 20 A/cm² at arc voltages between 100 V and 150 V. In order to utilize the discharge more efficiently multislit extraction geometry was adopted. Highest currents were obtained by using six slits, with a total extraction area of 1.35 cm². At an extraction voltage of 18 kV negative hydrogen ion currents close to 1 A were obtained, which corresponds to current densities of about 0.7 A/cm² at the extraction aperture. Pulse length was 10-20 ms and the repetition rate 0.1 Hz. The total extracted current was usually 2-3 times the H^- current. (auth)

8028 (CONF-741040—P1, pp 224-232) **Use of high power particle beams in fusion research.** Schilling, G. (Oak Ridge National Lab., TN). 1974.

From 3. conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In Proceedings of the third conference on application of small accelerators. Volume I. The use of small accelerators in research and teaching.

Particle beams charged and neutral, with energies from 1 to several hundred keV and currents from 0.1 to several hundreds of amperes, pulsed for a few msec to DC, are being used or their use planned for controlled thermonuclear fusion research. Applications include the heating and fueling of plasmas in present experimental devices toward reactor conditions, the ignition, fueling, and control of future fusion power reactors, the production of high-flux 14 MeV neutrons for reactor wall material radiation damage studies, sustaining a fusion engineering reactor device to study wall materials, and direct simulation of charged and neutral particle bombardment of reactor walls. (auth)

8029 (CONF-741040—P1, pp 233-240) **Advanced fuels for nuclear fusion reactors.** McNally, J.R. Jr. (Oak Ridge National Lab., TN). 1974.

From 3. conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In Proceedings of the third conference on application of small accelerators. Volume I. The use of small accelerators in research and teaching.

Should magnetic confinement of hot plasma prove satisfactory at high β (16 πnkT//sub B²/ greater than 0.1), thermonuclear fusion fuels other than D.T may be contemplated for future fusion reactors. The prospect of the advanced fusion fuels D.D and ^{6}Li.D for fusion reactors is quite promising provided the system is large, well reflected and possesses a high β. The first generation reactions produce the very active, energy-rich fuels t and ^{3}He which exhibit a high burnup probability in very hot plasmas. Steady state burning of D.D can ensue in a 60 kG field, 5 m reactor for β approximately 0.2 and reflectivity R/sub mu/ = 0.9 provided the confinement time is about 38 sec. The feasibility of steady state burning of ^{6}Li.D has not yet been demonstrated but many important features of such systems still need to be incorporated in the reactivity code. In particular, there is a need for new and improved nuclear cross section data for over 80 reaction possibilities. (auth)

8030 (LBL—4427) **Test facility for the development of 150-keV, multi-megawatt neutral beam systems.** Haughian, W.; Baker, W.R.; Biagi, L.A.; Hopkins, D.B. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1975. Contract W-7405-Eng-48. 6p. (CONF-751125—80). Dep. NTIS $4.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

The next generation of CTR experiments, such as the Tokamak Fusion Test Reactor (TFTR), will require neutral-beam injection systems that produce multi-megawatt, 120-keV deuterium-beam pulses of 0.5-second duration. Since present injection systems are operating in the 10- to 40-keV range, an intensive development effort is in progress to meet a 150-keV requirement. The vacuum system and power supplies that make up a test facility to be used in the development of these injectors are described. (MOW)

8031 (UCRL—77218) **Computer control and monitoring of neutral beam injectors on the 2XIIB CTR experiment at LLL.** Pollock, G.G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 18 Nov 1975. Contract W-7405-Eng-48. 9p. (CONF-751125—82). Dep. NTIS $4.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

The original manual control system for the 12 neutral beam injectors on the 2XIIB Machine is being integrated with a computer control system. This, in turn, is a part of a multiple computer network comprised of the three computers which are involved in the operation and instrumentation of the 2XIIB experiment. The computer control system simplifies neutral beam operation and centralizes it to a single operating position. A special purpose console utilizes computer generated graphics and interactive function entry buttons to optimize the human/machine interface. Through the facilities of the computer network, a high level control function will be implemented for the use of the experimenter in a remotely located experiment diagnositcs area. In addition to controlling the injectors in normal operation, the computer system provides automatic conditioning of the injectors, bringing rebuilt units back to full energy output with minimum loss of useful life. The computer system also provides detail archive data recording. (auth)

RADIATION HAZARDS

8032 (CONF-750989—1) **Experimental studies of tritium barrier concepts for fusion reactors.** Maroni, V.A.; Van Deventer, E.H.; Renner, T.A.; Pelto, R.H.; Wierdak, C.J. (Argonne National Lab., Ill. (USA)). 1975. Contract W-31-109-Eng-38. 34p. Dep. NTIS $5.00.

From International conference on radiation effects and tritium technology for fusion reactors; Gatlinburg, Tennessee, USA (30 Sep 1975).

Ongoing experimental studies at ANL aimed at the development of methods to reduce tritium migration in fusion reactor systems currently include (1) work on the development of multilayered metal composites and impurity-coated refractory metals as barriers to tritium permeation in elevated temperature (greater than 300°C) structures and (2) investigations of the kinetics of tritium trapping reactions in inert gas purge streams under conditions that emulate fusion reactor environments. Significant results obtained thus far are (1) demonstration of greater than 50-fold reductions in the hydrogen permeability of stainless steel structures by using stainless steel-clad composites containing an intermediate layer of a selected copper alloy and (2) verification that surface-oxide coatings lead to greater than 100-fold reductions in the hydrogen permeability of vanadium, but that severe oxygen penetration and embrittlement of the vanadium occur at temperatures in the range from 300 to 800°C and under conditions of extremely low oxygen potential. Other considerations pertaining to the large-scale use of metal composites in fusion reactors are discussed, and progress in efforts to demonstrate the fabricability of metal composites is reviewed. Also presented are results of studies of the efficiencies of (1) CuO and CuO-MnO_2 beds in converting HT to HTO and (2) magnesium metal beds in converting HTO to HT. (auth)

8033 (CONF-760202—5) **Health physics aspects of activation products from fusion reactors.** Shoup, R.L.; Poston, J.W.; Easterly, C.E.; Jacobs, D.G. (Oak Ridge National Lab., Tenn. (USA)). 1975. 14p. Dep. NTIS $4.50.

From 9. topical symposium on operational health physics; Denver, Colorado, USA (9 Feb 1976).

A review of the activation products from fusion reactors and their attendant impacts is discussed. This includes a discussion on their production, expected inventories, and the status of metabolic data on these products. (auth)

8034 (CONF-760202—9) **Occupational health physics at a fusion reactor.** Shank, K.E.; Easterly, C.E.; Shoup, R.L. (Oak Ridge National Lab., Tenn. (USA)). 1975. 6p. Dep. NTIS $4.50.

From 9. topical symposium on operational health physics; Denver, Colorado, USA (9 Feb 1976).

Future generation of electrical power using controlled thermonuclear reactors will involve both traditional and new concerns for health protection. A review of the problems associated with exposures to tritium and magnetic fields is presented with emphasis on the occupational worker. The radiological aspects of tritium, inventories and loss rates of tritium for fusion reactors, and protection of the occupational worker are discussed. Magnetic fields in which workers may be exposed routinely and possible biological effects are also discussed. (auth)

8035 (MLM—2259) **Evaluation study of the tritium-handling requirements of a Tokamak Experimental Power Reactor.** Wittenberg, L.J.; Bixel, J.C.; Braun, J.D.; Hobrock, D.L.; Kershner, C.J.; Miles, J.C.; Rhinehammer, T.B.; Watkins, R.A.; Wilkes, W.R. (Mound Lab., Miamisburg, Ohio (USA)). Nov 1975. Contract E-33-1-GEN-53. 32p. Dep. NTIS $4.00.

This report is a Mound Laboratory evaluation study of the tritium handling and containment technology common to all Tokamak Experimental Power Reactor (EPR) conceptual designs. The EPR is assumed to be fueled with a 50/50 deuterium-tritium mixture and to produce thermal power in the 150 to 450 MW range with mechanical power achieved by a steam turbine. The structure will be fabricated principally with stainless steel and no tritium breeding is anticipated during the initial operation. The necessary plant systems and associated administrative control requirements that are discussed include the plasma fuel and exhaust systems, the blanket and coolant system, the plant containment system, tritium accountability, and construction and operation of the reactor facility. (auth)

INERTIAL CONFINEMENT SYSTEMS

8036 (UCRL—51921) **Estimated refractive index and solid density of DT, with application to hollow-microsphere laser targets.** Briggs, C.K.; Tsugawa, R.T.; Hendricks, C.D.; Souers, P.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 16 Sep 1975. Contract W-7405-Eng-48. 19p. Dep. NTIS $4.00.

The literature values for the 0.55-μm refractive index N of liquid and gaseous H_2 and D_2 are combined to yield the equation $(N - 1) = [(3.15 +- 0.12) \times 10^{-6}]$rho, where rho is the density in moles per cubic meter. This equation can be extrapolated to 300°K for use on DT in solid, liquid, and gas phases. The equation is based on a review of solid-hydrogen densities measured in bulk and also by diffraction methods. By extrapolation, the estimated densities and 0.55-μm refractive indices for DT are given. Radiation-induced point defects could possibly cause optical absorption and a resulting increased refractive index in solid DT and T_2. The effect of the DT refractive index in measuring glass and cryogenic DT laser targets is also described. (auth)

8037 (UCRL—77040) **Computer simulation of laser-driven implosion of DT-filled glass microballoons.** Larsen, J.T. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 17 Oct 1975. Contract W-7405-Eng-48. 43p. (CONF-751130—5). Dep. NTIS $5.00.

From APS meeting; St. Petersburg, Florida, USA (10 Nov 1975).

The results of some experimental measurements of laser implosions are analyzed. Calculations are made of specific target irradiations and compared with experiments. A general description is given of exploding pushers and the physical processes involved are described. (MOW)

8038 (UCRL—77041) **Models of electron conductivity which lead to ablation stabilization of fluid instabilities in laser-driven implosions.** Lindl, J.D.; Mead, W.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 17 Oct 1975. Contract W-7405-Eng-48. 22p. (CONF-751130—8). Dep. NTIS $4.50.

From APS meeting; St. Petersburg, Florida, USA (10 Nov 1975).

LASNEX calculations with a modified electron conductivity show the existence of a firepolishing stabilization effect. By modifying the thermal conductivity so that K α T/sup n//rho/sup m/, one is able to construct a situation in which the electrons deposit their energy in a thin layer at the ablation surface and closely match the zero order solutions assumed earlier. The firepolishing effect appears to require that a significant fraction of the total pressure be due to the ablation process itself rather than the thermal pressure in the corona gas. It also requires KL approximately 1 where L is the scale height for decay of thermal perturbations generated at the ablation surface. For classical electron conductivity, because the thermal flux depends linearly on the grams/cm^2 necessary to stop the electrons, (1/rho) nabla rho approximately (1/T) nabla T near the ablation surface so that the pressure is nearly constant across the ablation surface. Hence there is no ablation pressure as such and no firepolishing effect for electron-driven implosions. (auth)

8039 (UCRL—77042) **Low power multiple shell fusion targets for use with electron and ion beams.** Lindl, J.D.; Bangerter, R.O. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 Oct 1975. 36p. (CONF-751108—17). Dep. NTIS $5.50.

From 1. international topical conference on electron beam research and technology; Albuquerque, New Mexico, USA (3 Nov 1975).

Use of double shell targets with a separate low Z, low density ablator at large radius for the outer shell, reduces the focusing and power requirements while maintaining reasonable aspect ratios. A high Z, high density pusher shell is placed at a much smaller radius in order to obtain an aspect ratio small enough to protect against fluid instability. Velocity multiplication between these shells further lowers the power requirements. Careful tuning of the power profile and intershell density results in a low entropy implosion which allows breakeven at low powers. Ion beams appear to be a promising power source and breakeven at 10-20 Terrawatts with 10 MeV alpha particles appears feasible. Predicted performance of targets with various energy sources is shown and comparison is made with single shell targets. (auth)

8040 (UCRL—77044) **Analysis of the ball-plate laser fusion target experiments.** Pan, Y.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Oct 1975. Contract W-7405-Eng-48. 18p. (CONF-751130—10). Dep. NTIS $4.50.

From APS meeting; St. Petersburg, Florida, USA (10 Nov 1975).

Two dimensional computer simulation results of the two exploding pusher ball-plate targets are in approximate agreement with the experimental space and time integrated x-ray spectra, x-ray microscope data, neutron yields, and laser energy absorptions. Three parameters were used to characterize the laser absorption due to plasma instabilities. Two dumpall parameters were used to model the energy absorption and a single variable was used to define the electron temperature. The values, as well as the selection procedure for these parameters are discussed. (auth)

8041 (UCRL—77045) **Fusion target designed to match present relativistic electron beam machine parameters.** Meeker, D.J.; Nuckolls, J.H.; Bangerter, R.O. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Nov 1975. Contract W-7405-Eng-48. 24p. (CONF-751130—12). Dep. NTIS $4.50.

From APS meeting; St. Petersburg, Florida, USA (10 Nov 1975).

The range of parameters considered for this design were restricted to beam voltages of 1 MeV and pulse widths of 50 ns, with zero rise and fall time. Total beam energy was varied from 10 kJ to 100 kJ. Descriptions are given of the target and electron deposition. Computer calculations are given of electron beam heating of the fuel.

8042 (UCRL—77048) **Stability and symmetry requirements of electron and ion beam fusion targets.** Bangerter, R.O.; Lindl, J.D.; Max, C.E.; Mead, W.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 14 Oct 1975. 37p. (CONF-751130—6). Dep. NTIS $4.50.

From APS meeting; St. Petersburg, Florida, USA (10 Nov 1975).

Considerations of hydrodynamic stability impose severe restrictions on the design of electron and ion beam imploded fusion targets. Furthermore, in order to obtain a sufficiently spherical implosion, many target designs require electron or ion beams having a high degree of spherical symmetry. The stability and symmetry requirements of several recently proposed target designs were studied by numerical simulation using the computer program LASNEX. The ion beam targets studied are more vulnerable to instability than the electron beam targets. (auth)

8043 (UCRL—77150) **Calculations of self-generated magnetic fields in parylene disc experiments.** Dahlbacka, G.H.; Mead, W.C.; Max, C.E.; Thomson, J.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 14 Oct 1975. Contract W-7405-Eng-48. 13p. (CONF-751130—9). Dep. NTIS $4.50.

From APS meeting; St. Petersburg, Florida, USA (10 Nov 1975).

Experiments have been planned at Livermore to measure self-generated magnetic fields using the Faraday Rotation of frequency quadrupled 1.1 μm laser light. The LASNEX code was used during the planning of these experiments and has provided valuable information in establishing the conditions under which the thermoelectric fields expected can be measured. Suspected thermoelectric fields have been inferred from experiments that have been carried out at NRL. (auth)

8044 **Reflective optics system for uniform spherical illumination.** Phipps, C.R. Jr.; Bodner, S.E.; Shearer, J.W. (Univ. of California, Livermore). *Appl. Opt.;* **14**: No. 4, 985-991(Apr 1975).

A reflective optical system is described that permits nearly uniform illumination of a small sphere with one or two laser beams. The primary application of this device is to studies of laser-driven implosion of small targets. Other applications include the production of plasma by optical breakdown of gases for spectroscopic studies and for optimum light collection in intensity limited plasma diagnostics. Simple calculations show that the intensity mapping properties of this system are not excessively sensitive to variations in the radial intensity distribution nor to departures from diffraction-limited propagation in the input beams. Optical damage and the illuminated solid angle required at the focus determine the size of the device. (auth)

8045 **Measurement of the ion temperature in laser-driven fusion.** Slivinsky, V.W.; Ahlstrom, H.G.; Tirsell, K.G.; Larsen, J.; Glaros, S.; Zimmerman, G.; Shay, H. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). *Phys. Rev. Lett.;* **35**: No. 16, 1083-1085(20 Oct 1975).

Using the time-of-flight technique, energy distribution measurements were made of the α particles emitted from laser implosions of DT gas in glass microshells. The number of nuclear reactions was determined by an absolute measurement of the number of α particles. From the width of the energy distributions, upper limits of the plasma ion temperature have been inferred. (AIP)

COMPONENT DEVELOPMENT AND TESTING

8046 (BNL—20681) **Cryocondensation pumping of thick films of hydrogen and deuterium.** Halams, H.J.; Bamberger, J.A. (Brookhaven National Lab., Upton, N.Y. (USA)). 1975. 10p. (CONF-751125—81). Dep. NTIS $4.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

In order to obtain engineering data for design of large capacity cryopumps for hydrogen, deuterium and tritium, an apparatus was built where pumping speeds and sticking coefficients can be studied as a function of surface coverage for different leak rates. In addition, thermal conductivity and thermal absorption of these frozen gases can be inferred from the measurements of pumping speed equilibrium pressure and the helium boil-off rate. The following changes in the above parameters were observed when the surface coverage was increased from a few atomic layers to 3.8×10^{20} molecules cm^{-2} for H_2 and 1.2×10^{21} molecules cm^{-2} for D_2: the pumping speed decreased about 10 percent while the equilibrium pressure and helium boil-off were unchanged within the limits of our measuring accuracy; changing the gas leak rate from 0 to 2×10^{-3} Torr liters sec^{-1} cm^{-2} also decreases the pumping speed by approximately 10 percent. From the above measurements it is inferred that thermal absorption to frozen H_2 and D_2 is negligible. Based on the information obtained in our investigation we designed a cryopump having a pumping speed of 10^5 liters sec^{-1} for hydrogen. (auth)

8047 (CONF-741040—P1, pp 259-269) **Radiation damage studies with accelerators.** Saltmarsh, M.J. (Oak Ridge National Lab., TN). 1974.

From 3. conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In Proceedings of the third conference on application of small accelerators. Volume I. The use of small accelerators in research and teaching.

Radiation damage is one of the major technological problems associated with future reactor development programs. In the hostile environment of a reactor core, drastic changes can occur in the properties of materials in ways which are generally complex and poorly understood. Direct measurement of these effects is difficult. Fission reactors have limited space, and experiments are often long and costly. No fusion reactor is yet available. As a result many laboratories are using accelerators to explore the various facets of radiation damage. The work at Oak Ridge is based mainly on the CN Van de Graaff and the Oak Ridge Isochronous Cyclotron. The program includes the simulation of high fluence neutron damage using heavy ion beams, examination of the effect of 14 MeV neutron bombardment on surfaces, the injection of He into materials to be subsequently irradiated, and various analytical techniques which involve accelerator beams. The experiments are directed not only toward an understanding of the fundamental mechanisms of radiation damage, but also toward development of techniques for rapidly testing the damage resistance of different alloys. (auth)

8048 (CONF-741040—P1, pp 270-277) **Use of heavy ion accelerators in fusion reactor-related radiation-damage studies.** Taylor, A.; Dobson, D.A. (Argonne National Lab., IL). 1974.

From 3. conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In Proceedings of the third conference on application of small accelerators. Volume I. The use of small accelerators in research and teaching.

The heavy-ion accelerator has become an important tool in the study of the fundamentals of radiation damage in fission- and fusion-reactor materials. Present facilities for such studies within the Materials Science Division at Argonne National Laboratory are provided by two complementary accelerator systems. Examples of the work carried out are discussed. (auth)

8049 (CONF-741040—P1, pp 278-286) **CTR related surface damage studies using small accelerators.** Das, S.K.; Kaminsky, M. (Argonne National Lab., IL). 1974.

From 3. conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In Proceedings of the third conference on application of small accelerators. Volume I. The use of small accelerators in research and teaching.

Small accelerators can be used to simulate some of the surface phenomena that will be encountered during the operation of controlled thermonuclear fusion reactors (CTR). A review of recent surface damage studies using low energy particle accelerators will be given. (auth)

8050 (CONF-741040—P1, pp 298-310) **Some surface effects of (D, T) neutrons on candidate fusion reactor materials.** Harling, O.K.; Thomas, M.T.; Brodzinski, R.; Rancitelli, L. (Pacific Northwest Lab., Richland WA). 1974.

From 3. conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In Proceedings of the third conference on application of small accelerators. Volume I. The use of small accelerators in research and teaching.

Measurements of fast neutron sputtering ratios for (D, T) neutrons incident upon metal foils are reported. Upper limits for forward sputtering of 4×10^{-4}, 4×10^{-4} and 8.3×10^{-4} atoms/ (D, T) neutron have been determined for single crystal Nb, annealed Nb and cold worked Nb respectively. Sputtering ratios for emission

of radioactive daughter atoms following (D, T) neutron induced reactions are reported for Nb, Au, Ti, Cu and V. Preliminary values of the sputtering ratio for Au are reported and these are lower than most previous results. A careful search for neutron sputtered micron sized particles yielded negative results. Some implications of radioactive atoms ejected from the walls of fusion reactors are discussed. (auth)

8051 (CONF-750875—1) **Surface effects in controlled thermonuclear fusion.** Kaminsky, M. (Argonne National Lab., Ill. (USA)). Aug 1975. Contract W-31-109-Eng-38. 54p. Dep. NTIS $5.50.

From International meeting on surface science; Milwaukee, Wisconsin, USA (Aug 1975).

During the operation of large size plasma facilities and future controlled thermonuclear fusion reactors the surfaces of such major components as container walls, beam limiters, diverter walls and beam-dump walls of the injector region will be exposed to particle and photon bombardment from primary plasma radiations and from secondary radiations. Such radiations can cause, for example, physical and chemical sputtering, blistering, particle- and photon-impact induced desorption, secondary electron and x-ray emission, backscattering, nuclear reactions, photo-decomposition of surface compounds, photocatalysis, and vaporization. Such effects in turn can (a) seriously damage and erode the bombarded surface and (b) release major quantities of impurities which will contaminate the plasma. The effects of some of the major surface phenomena on the operation of plasma facilities and future fusion reactors are discussed. (auth)

8052 (CONF-751125—70) **Particle emission from polycrystalline and monocrystalline niobium under 14.1 MeV neutron impact.** Kaminsky, M.; Das, S.K. (Argonne National Lab., Ill. (USA)). 1975. Contract W-31-109-Eng-38. 6p. Dep. NTIS $4.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

A brief review of recent results on particle emission from cold-rolled and annealed niobium with coarse surface finishes, and from monocrystalline niobium surfaces under 14.1-MeV neutron impact is given. For the cold-rolled and annealed samples two types of deposits were discovered on collector surfaces facing the irradiated targets. One type appeared as a fractional atom layer covering the surface, the other in the form of chunks. No chunk emission was observed for the monocrystalline niobium surface. The chunk deposits on the collectors facing the cold-rolled samples are not uniformly distributed over the collector area but are clustered along certain streaks or appear in patches. Furthermore, the number of chunks per unit collector area and the average chunk size were larger for the rough, cold-rolled samples than for the annealed samples. These observations suggest that the release of stresses (e.g. stresses caused by cold-rolling) in the surface regions by the energy deposited by primary recoils, and surface roughness affect the chunk emission significantly. Previously reported crude estimates of sputtering yields were improved on the basis of information which has become available from additional neutron irradiation runs. (auth)

8053 (CONF-751125—71) **X-ray impact induced desorption of gases from stainless steel surfaces.** Brumbach, S.; Kaminsky, M. (Argonne National Lab., Ill. (USA)). 1975. Contract W-31-109-Eng-38. 8p. Dep. NTIS $4.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

During the operation of plasma devices the interaction of energetic photons with surfaces can cause gas release by photodesorption, and thereby contribute to plasma contamination. Measurements of gases released from stainless steel surfaces were made in an ultrahigh vacuum environment using x-rays characteristic for a tungsten target bremsstrahlung spectrum for electron energies varying from 15 to 50 keV. The predominant gas species observed mass spectrometically are CO_2 (m/e = 44), CO (m/e = 28), and O_2 (m/e = 32). Mean quantum yields for the release of these species from stainless steel were determined. For example, for fresh stainless steel surfaces irradiated by x-rays produced by 50 keV electrons, a mean quantum yield for molecular CO_2 release of 3×10^{-4} molecules per photons in a bremsstrahlung spectrum at 50 keV electron energy was observed. Based on such a quantum yield an outgassing rate was determined. (auth)

8054 (CONF-751125—72) **Reduction of surface erosion caused by helium blistering: comparison between vacuum-cast and sintered-beryllium.** Das, S.K.; Kaminsky, M. (Argonne National Lab., Ill. (USA)). 1975. Contract W-31-109-Eng-38. 5p. Dep. NTIS $4.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

The blister formation and the erosion associated with blistering in a vacuum cast beryllium foil and in a foil of sintered beryllium powder have been investigated for irradiation at room temperature and at 600°C with 100 keV $^4He^+$ ions for total doses of 0.5 to 1.0 C cm^{-2}. For room temperature irradiation the blisters in sintered beryllium powder are smaller in size than in vacuum cast beryllium. For irradiation at 600°C large scale exfoliation of blisters was observed for vacuum cast beryllium but only small amount of exfoliation was seen for sintered beryllium powder. The results show a reduction in erosion rate in sintered beryllium as compared to the erosion rate in vacuum cast beryllium. For room temperature irradiation no erosion rate could be determined for the sintered beryllium foil since no blister exfoliation was observed. For 600°C irradiation the erosion rate for sintered beryllium foil is more than an order of magnitude smaller than for vacuum cast beryllium. (auth)

8055 (CONF-751125—73) **Irradiation of graphite cloth at various temperatures with deutrons and helium ions.** Ekern, R.; Das, S.K.; Kaminsky, M. (044 8000). 1975. Contract W-31-109-Eng-38. 6p. Dep. NTIS $4.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

Graphite cloth samples were irradiated with 100 keV deuterons and $^4He^+$ ions at room temperature and at elevated temperatures. Scanning electron microscopy was used to examine the surfaces of irradiated and unirradiated graphite fibers. Irradiation at room temperature with $^4He^+$ to a total dose of 3.1×10^{18} ions cm^{-2} produces considerable flaking of individual fibers, which is not observed on unirradiated fibers. Identical irradiations at 400° and 800° with $^4He^+$ did not produce any detectable flaking or other surface damage. The elevated temperatures apparently prevent an accumulation of helium in localized areas which in turn could cause flaking in near surface regions. Results obtained for deuteron bombardment of graphite cloth at room temperature and at 600°C are also discussed. (auth)

8056 (HEDL-SA—958) **Stress effects in ion bombardment experiments.** Garner, F.A.; Wire, G.L.; Gilbert, E.R. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Aug 1975. Contract E(45-1)-2170. 20p. (CONF-751026—34). Dep. NTIS $4.50.

From International conference on radiation effects and tritium technology for fusion reactors; Gatlinburg, Tennessee, USA (1 Oct 1975).

Ion bombardment is employed to simulate the neutron damage that will occur in fusion reactor structural materials. These experiments usually involve specimens whose thickness is large compared to the ion range. The correct interpretation of such experiments requires inclusion of the impact of swelling-induced stresses, which arise from the rigidity of the non-swelling region beyond the ion range. An initial low level of swelling is accommodated by elastic compression of the voided region, giving rise to anisotropic stresses whose deviatoric components lead to plastic deformation by various irradiation creep mechanisms. Swelling generates the stresses which lead to creep, which in turn limits the magnitude of stress. The hydrostatic stress along the ion range eventually saturates at a level which reduces the swelling rate from the anticipated stress-free value. The swelling is fully anisotropic, two-thirds of the deformation having been diverted from directions normal to the ion beam. Crystalline anisotropy further modifies the relative rates of creep processes, and radiation-hardening of the lattice imposes an additional fluence dependence. Stress reversal at denuded zones leads to second-order stress effects. The use of step height measurements allows observation and measurement of these phenomena. Estimates of the stress levels and swelling rates can be made using swelling and creep coupling coefficients derived from fission reactor data. A significant reduction in swelling rate is predicted by this analysis. (auth)

8057 (LA—6051) **Direct evaluation of transient surface temperatures and heat fluxes.** Axford, R.A. (Los Alamos Scientific Lab., N.Mex. (USA)). Aug 1975. Contract W-7405-ENG-36. 8p. Dep. NTIS $4.50.

Evaluations of transient surface temperatures resulting from the absorption of radiation are required in laser fusion reactor systems studies. A general method for the direct evaluation of transient surface temperatures and heat fluxes on the boundaries of bounded media is developed by constructing fundamental solutions of the scalar Helmholtz equation and performing certain elementary integrations. (auth)

8058 (LA—6118-MS) **Application of sensitivity analysis to a quantitative assessment of neutron cross-section requirements for the TFTR: an interim report.** Gerstl, S.A.W.; Dudziak, D.J.; Muir, D.W. (Los Alamos Scientific Lab., N.Mex. (USA)). Sep 1975. Contract W-7405-ENG-36. 43p. Dep. NTIS $4.00.

A computational method to determine cross-section requirements quantitatively is described and applied to the Tokamak Fusion Test Reactor (TFTR). In order to provide a rational basis for the priorities assigned to new cross-section measurements or evaluations, this method includes quantitative estimates of the uncertainty of currently available data, the sensitivity of important nuclear design parameters to selected cross sections, and the accuracy desired in predicting nuclear design parameters. Perturbation theory is used to combine estimated cross-section uncertainties with calculated sensitivities to determine the variance of any nuclear design parameter of interest. (auth)

8059 (LA-UR—75-2157) **Dependence of radiation damage analysis on neutron dosimetry.** Goland, A.N.; Parkin, D.M. (Los Alamos Scientific Lab., N.Mex. (USA)). 1975. Contract W-7405-Eng-36. 13p. (CONF-750935—13). Dep. NTIS $4.50.

From 1. ASTM-Euratom symposium on reactor dosimetry(developments and standarization; Petten, Netherlands (22 Sep 1975).

The characteristics of defect production in neutron spectra can be determined by utilizing neutron cross section data (e.g. ENDF/B), detailed neutron spectral data and radiation damage models. The combination of neutron cross section and spectral data is a fundamental starting point in applying damage models. Calculations using these data and damage models show that there are significant differences in the way defects are produced in various neutron spectra. Nonelastic events dominate the recoil energy distribution in high-energy neutron sources such as those based upon fusion and deuteron-breakup reactions. Therefore, high-energy neutron cross sections must be measured or calculated to supplement existing data files. Radiation damage models can then be used to further characterize the diverse neutron spectra. (auth)

8060 (MATT—1165) **Counterstreaming-ion tokamak neutron source for large area surface radiation studies.** Jassby, D.L. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). Nov 1975. Contract E(11-1)-3073. 35p. (CONF-750723—19). Dep. NTIS $4.00.

From International conference on radiation test facilities for the CTR surface and materials program; Argonne, Illinois, USA (15 Jul 1975).

A tokamak neutron source that produces a neutron flux approximately 10^{13} n/cm²/s over a wall test-area of 30 m² is designed using near state-of-the-art tokamak and neutral-beam injection technologies. To maximize fusion reactivity, D and T plasma ions are grouped in two distinct quasi-thermal velocity distributions, oppositely displaced in velocity along the magnetic axis. Such counterstreaming distributions can be set up by tangential injection of all plasma ions by oppositely directed D and T neutral beams, by facilitating removal of completely decelerated ions, and by minimizing plasma recycling. Fusion energy is produced principally by head-on collisions between D and T ions in the counterstreaming distributions. For injection energies of 40-60 keV, and typical tokamak parameters, the fusion power density can be approximately 1 W/cm³, with Q approximately 1 attainable for T/sub e/ = 3.4 keV and electron energy confinement parameter n/sub e/tau/sub E/ approximately equal to 2 x 10^{12} cm^{-3}s. All plasma fueling is carried out by the injected beams, and when a significant fraction of the electron population is trapped, the plasma current can be maintained by the beams. (auth)

8061 (ORNL-TM—5233) **INGRID: an intense neutron generator for radiation-induced damage studies in the CTR materials program.** Saltmarsh, M.J.; Worsham, R.E. (eds.). (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. vp. Dep. NTIS $7.75.

The proposal is broken into the following chapters: (1) the need for a neutron irradiation facility, (2) characteristics of the neutron source, (3) the accelerator, (4) the lithium target source, (5) buildings, utilities, and experimental facilities, and (6) project management, schedule, and costs. (MOW)

8062 (SAND—75-5443) **^{3}He release characteristics of metal tritides and scandium—tritium solid solutions.** Perkins, W.G.; Kass, W.J.; Beavis, L.C. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1975. 15p. (CONF-750989—2). Dep. NTIS $3.50.

From International conference on radiation effects and tritium technology for fusion reactors; Gatlinburg, Tennessee, USA (30 Sep 1975).

Tritides of such metals as scandium, titanium, and erbium are useful materials for determining the effects of helium accumulation in metallic solids, for example, CTR first wall materials. Such effects include lattice strain and gross deformation, as reported elsewhere, which are related to ^{3}He retention and ultimate release. Long term gas release studies have indicated that, during the early life of a metal ditritide, a large fraction of the ^{3}He is retained in the solid. At more advanced ages (2 to 4 years, depending on the parent metal), the ^{3}He release rate becomes comparable to the generation rate. Statistical analysis of the data indicates that the acceleration in ^{3}He release rate depends on accumulated ^{3}He concentration rather than strictly on age. ^{3}He outgassing results are presented for thin films of ScT_2, TiT_2, and ErT_2, and the critical ^{3}He concentrations are discussed in terms of a percolation model. Phase transformations which occur on tritide formation cast some doubt on the validity of extrapolating results obtained for metal tritides to predictions regarding the accumulation of helium in metals. Scandium is unique among the early transition and rare-earth metals in that the metal exhibits a very high room temperature tritium solubility (T/Sc = 0.4) with no phase transformation. Indeed, even the lattice parameters of the hcp scandium lattice are only minimally changed by tritium solution, and we have succeeded in obtaining single crystal $ScT_{0\text{-}3}$ samples in two crystallographic orientations. Using a very sensitive technique, we have measured ^{3}He emission from both these samples, as well as from fine-grained thin film scandium-tritium solid solution samples ($ScT_{0\text{-}3-0\text{-}4}$). The fine-grained film samples release ^{3}He at 2 to 3 percent of the generation rate, while the emission rate from the single-crystal samples is approximately 0.05 percent of the generation rate, indicating a strong grain size effect. (auth)

8063 (UCID—16978) **DT fusion neutron irradiation of BNL-LASL superconductor wires and LLL-BPNL aluminum foils.** MacLean, S.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 5 Sep 1975. Contract W-7405-Eng-48. 6p. Dep. NTIS $4.00.

The experimental technique for irradiating the Nb_3Sn multifilament wires and aluminium foils with 10^{18} neutrons/cm² is discussed. No test results are given. (MOW)

8064 (UCID—16979) **DT fusion neutron irradiation of BNL-LASL superconductor wires, WRDC electron microscopy, samples, BPNL molybdenum and nickel foils, and LLL aluminum tensile specimens.** MacLean, S.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 16 Sep 1975. Contract W-7405-Eng-48. 7p. Dep. NTIS $4.00.

The above samples were irradiated with 10^{18} neutrons/cm² from the LLL Rotating Target neutron source. Only the experimental technique is described. (MOW)

8065 (UCID—16980) **DT fusion neutron irradiation of BNL-LLL AL—1%CU wires, and LLL supracil.** MacLean, S.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.) 10 Sep 1975. Contract W-7405-Eng-48. 4p. Dep. NTIS $4.00.

The above samples were irradiated with 10^{18} neutrons/cm² from the LLL Rotating Target neutron source. Only the experimental technique is described. (MOW)

8066 (UCRL—77214) **2XIIB getter material problems.** Vogtlin, G.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 18 Nov 1975. Contract W-7405-Eng-48. 8p. (CONF-751125—78). Dep. NTIS $4.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

The uniformity of wire characteristics is vital to the reliable long-time operation of the titanium alloy wire. Of particular importance is the diameter, total emissivity, and alloy mix. The getter wire must be operated at a minimum rate while the life is determined by the maximum rate. At a particular current the difference between the maximum and minimum rate is determined by variations in wire characteristics. Small percentage variations in these characteristics can result in large variations in gettering rate. (auth)

8067 (UCRL—77219) **Electronics system for the LLL negative ion test stand.** Branum, D.R.; Kamppinen, L.M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 18 Nov 1975. Contract W-7405-Eng-48. 6p. (CONF-751125—79). Dep. NTIS $4.50.

From IEEE 6. symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

A test stand is in operation at LLL for the purpose of developing techniques and obtaining design information which will be used to develop efficient neutral beams. The knowledge gained will be used in the design of a 200 kV neutral beam test stand scheduled for operation in CY 77. (auth)

GENERAL AND MISCELLANEOUS

8068 (UCRL—50025-75-4) **Electronic Engineering Department Quarterly Report No. 4, 1975.** (California Univ., Livermore (USA). Lawrence Livermore Lab.). 8 Oct 1975. Contract W-7405-Eng-48. 29p. Dep. NTIS $4.00.

Separate abstracts were entered for the seven sections of this progress report. Five were included in Nuclear Science Abstracts, and all seven were included in ERDA Research Abstracts. (SFL)

MANAGEMENT

8069 (ERDA—63-75) **Physical Research Program: research contracts and statistical summary.** (Energy Research and Development Administration, Washington, D.C. (USA). Div. of Physical Research). 1 Jul 1975. 41p. Dep. NTIS $5.25.

The physical research program consists of fundamental theoretical and experimental investigations designed to support the objectives of ERDA. The program is directed toward discovery of natural laws and new knowledge, and to improved understanding of the physical sciences as related to the development, use, and control of energy. The ultimate goal is to develop a scientific underlay for the overall ERDA effort and the fundamental principles of natural phenomena so that these phenomena may be understood and new principles, formulated. The physical research program is organized into four functional subprograms, high-energy physics, nuclear sciences, materials sciences, and molecular sciences. Approximately four-fifths of the total physical research program costs are associated with research conducted in ERDA-owned, contractor-operated federally funded research and development centers. A little less than one-fifth of the costs are associated with the support of research conducted in other laboratories. (RWR)

8070 (ERDA—103) **1975 national survey of compensation paid scientists and engineers engaged in research and development activities.** (Battelle Columbus Labs., Ohio (USA)). 1 Nov 1975. 306p. GPO $3.70.

The aspects of this compensation survey considered are the sampling plan, basic data for survey analysis, entrance rates, trend analysis, geographic analysis, analysis of data, important qualifications concerning survey results, and computation of approximate confidence limits. Appendixes give salary tables for various subgroups of the entire sample. (RWR)

8071 (LF-tr—104) **German—French Research Institute of Saint-Louis list of publications.** May 1975. Translated from German. 4p. Dep. NTIS $3.50.

Titles of publications, authors, and descriptors are given. Most of the work dealt with sonic booms. (RWR)

MATHEMATICS AND COMPUTERS

8072 (AERE-R—7102) **Multiprocessor systems for reliability: a comparative study.** Taylor, J.R. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). May 1972. 89p. Dep. NTIS (US Sales Only) $6.00. UK pounds1.50.

Some of the problems in structuring both the hardware and software of multiprocessor systems to achieve high reliability are examined. Multicomputer systems are reviewed, and the advantage of multiprocessor systems is described. Different techniques for interconnection of hardware components of multiprocessor systems are compared. Techniques for structuring software for real time systems are described, and two ways of implementing this software structure in a multiprocessor system are compared. As a result of the comparisons, some techniques for implementation of multiprocessor systems are recommended. 39 figures, 11 tables (auth)

8073 (ANL—75-79) **Improved ASP I/O performance.** Engert, D.E. (Argonne National Lab., Ill. (USA)). Nov 1975. Contract W-31-109-Eng-38. 21p. Dep. NTIS $4.50.

An improvement to the I/0 routines of ASP is described, which can save 25% of the EXCPs issued by ASP. Unused buffers in the buffer pool are used to retain parts of the single track table, and only two modules are changed. 4 figures (auth)

8074 (BDX—613-1267(Rev.)) **Low frequency shielding of an experimental multiwire cable.** Stone, D.W. (Bendix Corp., Kansas City, Mo. (USA)). Jan 1976. Contract AT(29-1)-613. 28p. Dep. NTIS $4.00.

Shielding tests were conducted on an experimental cable and on four types of magnetic-shielding materials. Some of the manufacturing techniques of this cable satisfy the design requirements of a security cable for the transfer of data between computer terminals. The electric and magnetic shielding characteristics of the cables were researched in relationship to the security requirements. The magnetic shielding efficiencies of the four different materials were measured for possible use in the design of a magnetic shield with characteristics superior to thin-walled steel conduit. 17 figures, 1 table. (auth)

8075 (BNWL-B—449) **Handler for the VERSATEC serial printer interface.** Kosork, J.R. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Sep 1975. Contract E(45-1)-1830. 23p. Dep. NTIS $4.00.

It was necessary to write a second handler for the Versatec printer on the PDP-15 in order to get properly paged listings when using an externally developed cross-assembler. The listing of the handler defines its control structure as well as showing the coding. Control structures, such as IF THEN ELSE, are shown as comments and then implemented in the PDP-15 assembly language. 2 tables (auth)

8076 (CIC-D—1.2-001) **Romberg integration.** Fritsch, F.N. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 May 1967. 31p. Dep. NTIS $4.75.

The Romberg algorithm provides a fast and accurate method for numerically approximating the definite integral of the function f(x) from a to b where a FORTRAN function is available for calculating the integrand. Implementation of the algorithm in several machines is explained, and FORTRAN listings of several versions are given. It should be noted that the coding is rather dated, as the report was issued in 1967. 1 figure, 5 tables (RWR)

8077 (CISE-N—175) **Computational experience with quasi-Newton algorithms for minimization problems of moderately large size.** Spedicato, E. (Centro Informazioni Studi Esperienze, Milan (Italy)). Oct 1975. 38p. Dep. NTIS (US Sales Only) $4.00.

Two quasi-Newton algorithms, known as the BFS and the OS method, for the unconstrained minimization of nonlinear functions are compared on a set of significant problems up to 80 variables. It is shown that, when the minimization is started with the unit matrix, the performance of the BFS deteriorates with growing n more rapidly than the performance of the OS. A way to scale the initial matrix in some cases is also suggested; this results in greatly improving the performance of the BFS, which becomes competitive with the OS even for large problems. 10 tables (auth)

8078 (COO—3077-82) **Accelerated iteration schemes for transonic flow calculations using fast Poisson solvers.** Jameson, A. (New York Univ., N.Y. (USA). Courant Inst. of Mathematical Sciences). Mar 1975. Contract E(11-1)-3077. 20p. Dep. NTIS $3.50.

Results obtained by using a fast Poisson solver to accelerate the rate of convergence of the iterative scheme are described. A fast iterative method for transonic flow calculations is formulated first, and then application is made to the transonic potential flow equation in a mapped domain. It is concluded that the use of a fast elliptic solver in combination with relaxation is an effective way to accelerate the convergence of transonic flow calculations, particularly when a marching scheme can be used to treat the supersonic zone in the relaxation process. 3 figures (RWR)

8079 (DEMO—76/1) **Parametric identification using discrete Laguerre polynomials.** Paraskevopoulos, P.N.; King, R.E. (Democritus Nuclear Research Center, Athens (Greece)). Jan 1976. 19p. Dep. NTIS (US Sales Only) $3.50.

A fast numerical technique for parameter identification of linear time-invariant discrete systems is presented. The technique is based on a representation of input and output sequences by means of truncated discrete Laguerre series. 2 tables (auth)

8080 (IS—3339) **ALECS language reference manual.** Campbell, J.H.; Covert, G.F.; Helland, B.J. (Ames Lab., Iowa (USA)). Jan 1976. Contract W-7405-eng-82. 97p. Dep. NTIS $5.00.

The Ames Laboratory Experimental Control System (ALECS) programing language is a subset of the PL/I programing language. This manual supplements the PL/I reference manual by detailing the additions to the PL/I language as well as listing the implementation restrictions where appropriate. 17 tables (auth)

8081 (IS—3773) **Users manual for 0S910, the SDS-910 operating system.** Moon, L.C. (Ames Lab., Iowa (USA)). Dec 1975. Contract W-7405-eng-82. 33p. Dep. NTIS $4.00.

This document is designed for the users of the OS910 real-time operating system for the SDS-910—PDP-15 computer network. It describes what information the user must provide to the system for successful operation. Included is a description of all programed operators (POPS) that will be of use to the user. 2 tables (auth)

8082 (JINR—P11-9222) **Convergence of the generalized Newton method.** Avramov, S.R. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1975. 16p. (In Russian). Dep. NTIS (US Sales Only) $3.50.

The problems of nonlocal convergence of the generalized Newton method for the case of the Banach spaces are investigated. A theorem on total convergence of the generalized Newton method is obtained. (auth)

8083 (JUL—1004-MA) **JOKER: a system for the coupling of experiment computers of various manufacture with a central time-sharing computer.** Conrads, D.; Moritz, H.E.; Muehlstroh, R. (Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany). Zentralinstitut fuer Angewandte Mathematik). Oct 1973. 93p. Dep. NTIS (US Sales Only) $6.00.

A highly flexible two-stage system for coupling experimental data acquisition computers with a central time-sharing computer is described. One of the basic features of the system is its ease of operation by the experimenter, and this is described. The internal structure of the system and the operation of the individual components are described in greater detail. The hardware, operational system in the PDP 11 organization computer, and the coupling software are considered. 17 figures (JSR)

8084 (KFK—1749) **CALAS 69/4: a realtime operating system with interactive data manipulation for laboratory automation and process control.** Kursawe, P.; Rietzschel, K.; Veith, H. (Kernforschungszentrum Karlsruhe (F.R. Germany). Abt. Datenverarbeitung und Instrumentierung). Aug 1975. 98p. Dep. NTIS (US Sales Only) $6.00.

The hardware and software components of the central laboratory automation system CALAS, consisting of two compatible TR86 computers and process peripherals developed at ADI (Abteilung Datenverarbeitung und Instrumentierung) are discussed. The system described can control up to 28 complex processes. It has been in full operation since 1974, permanently servicing on an average 13 experimental installations in the areas of physics, chemistry, meteorology, and process control. The experimental equipment or process can be managed at a distance of up to 2 km. Peripheral devices are connected to the central processing system over a special network of fast data transmission lines. A display unit is used to control the equipment and for data manipulation and evaluation as well. 16 figures (auth)

8085 (KFK—2204) **Definition, translation, and application of user-oriented languages as extensions of PL/1 in the CAD-systm REGENT.** Enderle, G. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Reaktorentwicklung). Sep 1975. 162p. (In German). Dep. NTIS (US Sales Only) $7.75.

The integrated CAD-system REGENT serves for modular development of programs for different application areas, for management of data storage and data transfer, and easy and safe application of programs by means of user-oriented languages. Programs, data, and language for an application area form a REGENT subsystem. The problem language system of REGENT, PLS (Problem Language System), provides facilities for the development of a problem-oriented language for every subsystem as extensions of the base language PL/1. The translation of problem-oriented languages by a precompiler into PL/1 and the definition of language extensions and data structures for subsystems are described. Development and application of the language for a fluiddynamics subsystem are shown. (30 figures) (auth)

8086 (KFK-PDV—47) **Method for performance comparison of ddc algorithms and application of this method to selected cases by means of the computer program OPTAL.** Patzelt, W.; Salaba, M. (Gesellschaft fuer Kernforschung m.b.H., Karlsruhe (F.R. Germany)). Jul 1975. 69p. (In German). Dep. NTIS (US Sales Only) $4.50.

Characteristics and test setups are defined for the comparison of direct digital control algorithms for single variable control. Under the test setup process, process controller, signal, the control algorithms to be compared are characterized by the characteristics quality measure, sensitivity measure, costs. The defined characteristics under the defined test setups are investigated for four types of algorithms designed with respect to deadbeat response, minimal integrated squared error, quantity optimum (PID structure), quantity optimum with compensation of dead time by the process model (PID structure). A digital computer program "OPTAL" for design and simulation of direct digital control is used. (2 figures, 10 tables) (auth)

8087 (KFK-PDV—53) **PROCESS BASIC.** Wagner, F.; Woda, H. (Gesellschaft fuer Kernforschung m.b.H., Karlsruhe (F.R. Germany)). Aug 1975. 162p. (In German). Dep. NTIS (US Sales Only) $6.75.

PROCESS BASIC is a programing system for process control and scientific applications by means of a mini-computer. The PROCESS BASIC language consists of the high-level programing language BASIC, a powerful macro-assembly language, and the machine code of the computer used. These three language levels can be mixed line by line. Formated input/output statements and statements for interrupt handling and real-time programing are available. Any process peripherals can be connected to the system easily via a simple software interface. The complete system consists of a one-pass-translator, a loader, a linkage-editor, and a newly developed operating system using 8K (20 bits) of working storage. PROCESS BASIC was implemented on a UNICOMP 201 computer. (auth)

8088 (KFKI—75-56) **STAGE2 macroprocessor.** Zimanyi, M. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). 1975. 70p. (In Hungarian). Dep. NTIS (US Sales Only) $5.50.

STAGE2 is a general purpose language-independent macroprocessor, developed by W. M. Waite, mainly for implementing portable software. The macroprocessor, itself a piece of highly portable software, was implemented on the ICL 1905 computer by bootstrapping. This report can serve as a user's manual of STAGE2. Some examples of the application of the processor for language extension, language translation, and text generation are given. (auth)

8089 (LBL—4240) **Graphics modeling techniques in computer aided design.** Holmes, H.H. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1975. Contract W-7405-ENG-48. 201p. Dep. NTIS $7.75.

Thesis.

A comprehensive approach to problem solving using schematic diagrams as the interface between man and computer is described. Past efforts at computer-aided design have been hampered by an approach which combined the man—machine problem-description interface with the problem analysis portion of the system. This work employs a methodology which separates these two aspects of computer-aided design. GMS is able to provide a single man—machine problem description interface for use in a wide variety of problem-solving disciplines. In addition, GMS includes intermediate data structures and preprocessing facilities that form a natural interface and starting point for the creation of additional analysis capabilities. The problem-definition interface supports two main activities: the creation of elements and the interconnection of these elements to form diagrammatic models. The problem-solving portion of the methodology allows a wide variety of analysis techniques which can be flexibly combined to solve a particular problem at hand. Extension of existing problem-solving systems using the graphics problem description interface is also described. 32 figures (auth)

8090 (LTSS—209(Ed.1)(Pt.3)) **Livermore time-sharing system. Part III. Problem program production. Chapter 209. LLL—APL user's manual.** Wilgus, C.A.; Zwakenberg, R.G.; Dairiki, N.T. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Feb 1975. 177p. Dep. NTIS $8.50.

APL language functions are defined and then illustrated in examples. In addition to the basic primitive and mixed language functions, user-defined functions, system commands, and I-beam functions are covered, as well as unique features of LLL APL that include the reading and writing of files. Both LLL-APL keyboard symbols and standard APL keyboard symbols are presented. The intent is to give the reader a working knowledge of the APL interpretive operating system at LLL and to permit him to make the transition readily to a standard APL keyboard when necessary. 7 figures, 12 tables (auth)

8091 (ORNL-TM—5199) **FBSAM data transmission package for IBM 360/370 computers.** Rhoades, W.A. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 53p. Dep. NTIS $5.50.

The FBSAM subroutine package provides rapid movement of large blocks of data directly between user storage arrays and magnetic disk data sets. No buffer space is required. Large reductions in data transmission time and number of I/0 requests can be obtained. Moves can be concurrent with each other and with computation. A form of random access is available. A demonstration program provides a thorough test of all features. The package is intended for use by FORTRAN programers with little or no assembler language experience. It should be operable on most IBM 360/370 machines. A sample application to an I/0-bound code is discussed. The use of three concurrent functions entirely eliminated the real time associated with data transmission tasks by allowing them to proceed concurrently with other tasks. 2 figures, 1 table (auth)

8092 (RISO—309) **Elements of automata theory and the theory of Markov chains.** Lind, M. (Danish Atomic Energy Commission, Risoe. Research Establishment). Mar 1975. 87p. Dep. NTIS (US Sales Only) $6.00.

Selected topics from automata theory and the theory of Markov chains are treated. In particular, finite-memory automata are discussed in detail, and the results are used to formulate an automation model of a class of continuous systems. Stochastic automata are introduced as a natural generalization of the deterministic automaton. Markov chains are shown to be closely related to stochastic automata. Results from Markov chain theory are

thereby directly applicable to analysis of stochastic automata. This report provides the theoretical foundation for the investigation in Riso Report No. 315 of a class of self-organizing control systems. (25 figures) (auth)

8093 (RISO-M—1594(Ed.2)) **Risoe hybrid computer EAI 680—PDP8/I,FPP12. 2 edition.** Hoejberg, K.S. (Danish Atomic Energy Commission, Risoe. Research Establishment). Sep 1975. 26p. Dep. NTIS (US Sales Only) $4.50.

The system configuration (EAI 680 analog computer, interface unit, digital computer) and the software system (monitor, compilers, assemblers, assisting programs) are described concisely. The general tenor of the report is that of a user's introduction. (3 figures, 14 tables) (RWR)

8094 (SAND—75-0424) **VISAR data reduction.** Young, E.G.; Barker, L.M. (Sandia Labs., Albuquerque, N.Mex. (USA)). Nov 1975. Contract AT(29-1)-789. 65p. Dep. NTIS $5.50.

The data reduction theory which allows both specimen surface velocity and surface velocity distribution to be determined from the data of the Velocity Interferometer System for Any Reflector (VISAR) is presented. Two time-sharing, user-interactive computer programs which implement the theory are described, and the program listings are provided. (auth)

8095 (SAND—75-8742) **High-speed digital filters using residue number arithmetic.** Soderstrand, M.A. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1975. 5p. (CONF-751109—3). Dep. NTIS $4.50.

From 9. annual asilomar conference on circuits, systems and computers; Pacific Grove, California, USA (3 Nov 1975).

A technique is described for implementing digital filters using residue number arithmetic. Recursive, as well as non-recursive, digital filters may be realized since the required multiplication by a fraction is accomplished by using table look-up methods rather than the slower residue technique. The resulting circuit is an economical high-speed digital filter structure which is suitable either for implementation using commercially available components, or for mass production of digital filters for the consumer. 7 figures (auth)

8096 (SLAC—186) **Survey of techniques for fixed radius near neighbor searching.** Bentley, J.L. (Stanford Linear Accelerator Center, Calif. (USA)). Aug 1975. Contract E(04-3)-515. 21p. (STAN-CS—75-513). Dep. NTIS $3.75.

This paper is a survey of techniques used for searching in a multidimensional space. Although the problem of searching for fixed-radius near neighbors (that is, all points within a fixed distance of a given point) is the one specifically considered, the structures presented here are applicable to many different search problems in multidimensional spaces. The orientation of this paper is practical; no theoretical results are presented. Many areas open for further research are mentioned. 4 figures (auth)

8097 (UCCND-CSD—2) **Subjective probability estimates of resources model: program user's manual.** Van Wie, N.H. (Union Carbide Corp., Oak Ridge, Tenn. (USA). Nuclear Div.). Dec 1975. Contract W-7405-eng-26. 122p. Dep. NTIS $5.45.

The objectives of the Subjective Probability Estimates of Resources Model are conversion of estimates concerning mineral resources expressed in probabilistic terms into mean or "most likely" values; accumulation of these estimates into mean values for a sub-area of land and derivation of secondary attributes of the mineral deposit; aggregation of the information concerning the sub-areas into overall area estimates; application of an economic model to these estimates to derive estimates of the cost of developing, extracting, and milling the mineral; statistical comparisons of estimates of geologists grouped by using a self-appraisal index of confidence; and preparation of reports, both tabular and graphic, that present the results. This report describes the computer programs that implement these objectives. The application of them to a study of the potential for uranium resources in undiscovered deposits in New Mexico has been described elsewhere. [GJO-109]. 3 figures, 2 tables. (auth)

8098 (UCCND-CSD—3) **Monte Carlo sampling of subjective probability estimates.** Van Wie, N.H. (Union Carbide Corp., Oak Ridge, Tenn. (USA). Nuclear Div.). Dec 1975. Contract W-7405-eng-26. 54p. Dep. NTIS $5.45.

This program was prepared for the purpose of sampling and analyzing subjective probability estimates about a mineral resource in an area subdivided into smaller geographic entities. Estimates from over 30 geologists were expressed in probabilistic terms for attributes of numbers of deposits and tons/grade of ore for each of over 60 geographic areas. The functional application of the program is described elsewhere [GJO-109], and this report is intended to facilitate its usage or modification in a local installation. In the discussion herein, a "sample" consists of generating pseudorandom numbers, testing them against two cumulative distribution functions for each of 3332 ore body descriptions, and compilation of pertinent statistics. (3 figures) (auth)

8099 (UCCND-CSD—4) **Subjective probability estimate data base management programs. Program user's manual.** Van Wie, N.H. (Union Carbide Corp., Oak Ridge, Tenn. (USA). Nuclear Div.). Dec 1975. Contract W-7405-eng-26. 62p. Dep. NTIS $5.45.

The subjective probability assessment of uranium resources requires the analysis of resource estimates provided by a number of geologists relative to a number of geographic areas. These estimates have been provided by GJO in machine-readable form. A group of programs was prepared to make these estimates readily accessible for EDP-based analysis by the Delphi and Monte Carlo programs described in UCCND-CSD-2 and -3. The ability to print any given estimate in the format of the questionnaire sheet (the interface with the geologist) is included. These utility programs are described herein. 1 figure (auth)

8100 (UCCND-CSD-INF—74) **Utility routines for tridiagonal matrices.** Park, J.E. (Union Carbide Corp., Oak Ridge, Tenn. (USA). Nuclear Div.). Nov 1975. Contract W-7405-eng-26. 36p. Dep. NTIS $5.00.

A family of FORTRAN subroutines to perform several operations on tridiagonal coefficient matrices and related vectors, matrices, and linear systems is presented. Detailed descriptions of the subroutine arguments are given. Results of two test cases are presented and compared to solutions obtained by using the standard routine DMATEQ. 1 figure, 4 tables (auth)

8101 (UCID—16913) **UNIVAC parser.** Chin, J.S. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 2 Oct 1975. Contract W-7405-Eng-48. 118p. Dep. NTIS $5.45.

The Research in Secured Operating Systems (RISOS) group of Lawrence Livermore Laboratory conducted a review of the security of the UNIVAC 1100 Series Operating System, with specific reference to the modified system at the Naval Command System and Support Activity in Washington. Before conducting a test and evaluation of any particular system, RISOS must be provided with a copy of the system source listings. These listings are then parsed into a number of uniformly formated data bases: parsed data structure and total source listings. This report describes in detail the parser written for the UNIVAC 1100 Series Operating System, and includes a listing of the parser. 1 figure (RWR)

8102 (UCID—30123) **Star "basic" mathematical subroutines.** von Holdt, R.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 18 Dec 1975. Contract W-7405-Eng-48. 38p. Dep. NTIS $4.00.

The following mathematical subroutines are described: FEXP (Full-Word Exponential Function), HEXP (Half-Word Exponential Function, FLOG (Full-Word Logarithm Function), HLOG (Half-Word Logarithm Function), FE2I (Full-Word Cos-Sin Function), HE2I (Half-Word Cos-Sin Function), FR2P (Full-Word Rectangular-to-Polar Transformation Function), HR2P (Half-Word Rectangular-to-Polar Transformation Function), FSAT (Full-Word Arctangent Function), and HSAT (Half-Word Arctangent Function). Assembly language listings are provided for those beginning with F. 15 figures, 2 tables (auth)

8103 (UCID—30125) **REDPP: a postprocessor for the TRIX/RED report editor.** Beatty, J.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Nov 1975. Contract W-7405-Eng-48. 74p. Dep. NTIS $5.45.

REDPP, a new postprocessor for the TRIX/RED report editor, accepts a six-bit ASCII file as input and uses TV80LIB to produce output for the FR80, dd80, TMDS-I, TMDS-II, and/or a Versatec printer. Text can be generated in several different Hershey character fonts. REDPP incorporates all of the facilities available via the TRIX/AC PRINT command includes many new features. (auth)

8104 (UCRL—51900) **Experimental inquiries: a mathematical approach.** Corynen, G.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Sep 1975. Contract W-7405-Eng-48. 25p. Dep. NTIS $4.00.

The practice of simulation is intimately intertwined with the exact sciences and yet itself has remained much an art. There exists no satisfactory mathematical theory of simulation, and no definition of simulation which is both precise and useful for scientific and engineering purposes. The need for such a theory has developed particularly in recent years because the problems which science and engineering are attempting to attack have become increasingly complex and have acquired an increasingly interdisciplinary character. In this paper, an initial effort is made to endow the

practice of simulation with more rigorous contents. A definition of simulation is developed in terms of two central concepts: a model and an experimental inquiry. The former concept has been formalized in earlier publications; the latter is developed here as a 4-tuple, I = [PSI,Q,M,D], where PSI is a set of experimental objects, Q is a set of questions, M is a sampling plan or experimental design, and D is a decision strategy. The essential purpose of this paper is to formulate a framework to unify rigorously the important methodological principles underlying the practice of simulation, and initial results demonstrate the usefulness of the formulation. First, it is shown that the continuous composition of questions has little effect on simulation relationships. Then the developed framework is used to determine the probability that simulation predictions are epsilon-correct for simulation experiments of arbitrary length n. 8 figures (auth)

8105 (UCRL-Trans—10978) **Difference schemes for equations with discontinuous coefficients.** Tikhonov, A.N.; Samarskii, A.A. Translated from *Dokl. Akad. Nauk SSSR;* **108**: No. 3, 393-396(1956). 7p. Dep. NTIS $3.50.

For convenience in the solution of differential equations by computer, it is desirable that one and the same difference scheme be applicable to the solution of differential equations with both continuous and discontinuous coefficients, without the explicit distinguishing of the points of discontinuity. This problem is discussed with the aid of the following boundary value problem: L/sup (k)/y = (d/dx)[k(x)(dy/dx)] = -f(x), (0 less than x less than l), y(0) = y'(l) = 0, in the class of piecewise-continuous coefficients k(x) greater than or equal to k_0 greater than 0. Only linear homogeneous schemes are considered. (RWR)

8106 **Cubic spline formulation for matrix method for second order ordinary differential eigenvalues.** Young, J.D.; Luger, P. (Univ. of Seattle). *J. Comput. Phys.;* **5**: No. 169, 73-95(1970).

A cubic spline formulation for the matrix method in solving for secondary-order ordinary differential eigenvalues is described. The matrix method formulates the matrices in terms of finite difference approximations. Rows of the matrices corresponding to boundary points relate to boundary conditions only and not to the differential equation. The cubic spline formulation constructs the "boundary point" rows in such a way that both boundary condition and differential equation are satisfied. For each eigenvalue so approximated, a corresponding eigenfunction is computed. An integral ratio (modified Rayleigh quotient) process is applied to this function to improve the eigenvalue approximation. Numerical examples are given to illustrate the method and compare it with the finite difference formulation. (auth)

8107 **Feasibility study and functional design for the computerized automation of the Central Regional Laboratory EPA Region V, Chicago.** Frazer, J.W.; Barton, G.W. Jr. (Univ. of California, Livermore). *Am. Soc. Test. Mater., Spec. Tech. Publ.;* **578**: 152-256(1975).

A feasibility study and functional design are presented for the computerized automation of the Central Regional Laboratory of Region V of the Environmental Protection Agency. The system recommended, which meets all the stated objectives, is built around a Data General Nova 840 computer operating in a time-share mode using the BASIC high-level language operating system for applications programs. Instruments to be automated include Technicon AutoAnalyzers, atomic absorption spectrometers, and an electronic balance. The system will include file management programs to take care of the laboratory needs. Data will be transferred to STORET on magnetic tape. This paper is divided into several sections. The first section includes an overview of the functions selected by the laboratory for consideration with a discussion of the benefits expected from automation of these functions, and a detailed cost and benefit breakdown of ten alternatives, each meeting the same or all of the objectives. The final sections are functional designs for each of the instruments and the sample file control, detailing the desired interaction between the operators, instruments, and data. The goals of this project are to increase instrument capacity, improve the accuracy and precision of analytical results, save analysts' time, reduce clerical time and associated errors, and provide ready access to the analytical data. 21 figures, 3 tables. (auth)

8108 **Aspects of nonlinear block successive overrelaxation.** Hageman, L.A.; Porsching, T.A. (Westinghouse Electric Corp., West Mifflin, PA). *SIAM (Soc. Ind. Appl. Math.) J. Numer. Anal.;* **12**: No. 3, 316-335(Jun 1975).

The solution of the nonlinear system Fx = 0 by the nonlinear block Gauss--Seidel (NBGS) and the nonlinear block successive overrelaxation (NBSOR) methods is considered. If F is an M-function, a theorem which compares the convergence rates of the NBGS method for different block groupings is given. For the NBSOR method, an a posteriori numerical strategy for determining an optimum relaxation parameter ω is described which is based on an asymptotic application of the theory developed by Young for 2-cyclic matrices. An inner iteration procedure based on Newton's method for solving the block subsystems is also given. Numerical results are included. 4 figures, 6 tables (auth)

8109 **Dispersion and Gibbs phenomenon associated with difference approximations to initial boundary-value problems for hyperbolic equations.** Chin, R.C.Y. (Univ. of California, Livermore). *J. Comput. Phys.;* **18**: No. 3, 233-247(Jul 1975).

The problem of the semidiscretized approximation for the initial boundary-value problem of the wave equation is analyzed. Pointwise convergence properties for the propagation of discontinuities are investigated via a uniformly valid asymptotic expansion. An approximate error analysis using matched asymptotic expansions is constructed and compared with the asymptotic expansion of the exact solution. 2 figures (auth)

8110 **Algorithm for finding nearest neighbors.** Friedman, J.H. (Stanford Linear Accelerator Center, CA.); Baskett, F.; Shustek, L.J. *IEEE (Inst. Electr. Electron. Eng.) Trans. Comput.;* 1000-1006(Oct 1975).

An algorithm that finds the k nearest neighbors of a point, from a sample of size N in a d-dimensional space, with an expected number of distance calculations E[n/sub d/] < or approximately equal to π/sup $^{-1}/_{2}$/[kdΓ(d/2)]/sup 1/d/(2N)$^{1-}$/sup (1/d)/ is described, its properties are examined, and the validity of the estimate is verified with simulated data. (6 figures) (auth)

8111 **Time response and bandwidth in laboratory automation.** Frazer, J.W.; Brubaker, T.A.; Van Drie, J.H. (Univ. of California, Livermore). *Proc. IEEE (Inst. Electr. Electron. Eng.);* **63**: No. 10, 1503-1508(Oct 1975).

In laboratory automation, the computer is used for a variety of tasks including data acquisition, data analysis, control, and report and graph generation. For automation to be successful, it is necessary to generate system specifications carefully and to proceed to an implementation design before becoming concerned about the actual computer. This forces the design team to consider the requirements to handle and process data without the constraints of a specific computer. For real-time applications, two key specifications are time response and bandwidth. In this paper, these quantities are defined, and their effect on the operation of a computer system is discussed. A detailed example of an actual system is then presented to illustrate how time response and bandwidth are handled. 4 figures, 1 table (auth)

INFORMATION HANDLING

8112 (JUL—1013-WT) **Review of a planning and information system in the KFA.** Bahr, R.E. (Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany). Wissenschaftlich-Technische Abt.). Oct 1973. 67p. Dep. NTIS (US Sales Only) $5.50.

A review is given of the presently installed planning and information system at the Nuclear Research Installation. Possibilities for the design of new systems, which arise from the modular application of tested program systems, are indicated. The review is part of the work being done on a management-information system pertinent to the problems and interests of the Installation. 8 figures (tr-auth)

8113 (LBL—3699) **Overview of the LBL Socio-Economic-Environmental-Demographic Information System. (SEEDIS).** Austin, D.M.; Kranz, S.G.; Quong, C. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1975. Contract W-7405-Eng-48. 49p. Dep. NTIS $5.50.

A Socio-Economic-Environmental-Demographic Information System (SEEDIS) was developed by the Mathematics and Computing Group of Lawrence Berkeley Laboratory. This paper indicates the philosophy and motivation which led to the development of SEEDIS and briefly describes each of its component projects. Appendices include a listing of LBL's current data bases, descriptions and sample formats of reports prepared for the manpower indicator program, and a description of and examples of maps generated utilizing the LBL computer mapping system. (auth)

LAW

8114 (ERDA-tr—77) **Law on conduct of activities in the nuclear field in the Socialist Republic of Romania.** 1974. Translated from Buletinul oficial al Republicii Socialiste Romania, Part I, No. 136. 15p. Dep. NTIS $4.50.

Details are given of a law that incorporates provisions designed to ensure the introduction, development and use of

nuclear energy and nuclear techniques in the economy and in public life, the development of scientific research in this field, and industrial application of the results of such research on the basis of a national nuclear program. (auth)

CORPORATE INDEX

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Allied Chemical Corp., Buffalo, N.Y. (USA). Specialty Chemical Div.
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Annual technical progress report nuclear safety characterization of sodium fires and fast reactor fission products, government fiscal year 1975, 1:6787 (AI-ERDA—13155)
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AUTHOR INDEX

Authors' surnames are indexed in the form appearing in the abstracted publication; given names are reduced to initials. Each author entry gives the publication title and the citation number. Report numbers are given in parentheses at the end of the entry. For publications with multiple authors, an author entry is provided for each. Entries for the second and succeeding author give a reference to first author.

Because of problems involved in the mechanical preparation of this index, all accent marks are omitted. Changes in spelling introduced as a result of accent omission follow standard conventions.

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The title may be supplemented with additional words, or a phrase, if it appears additional information would be helpful. In cases for which the title contains little or no information related to the subject entry, it may be replaced entirely by the supplementary information. A qualifier is not always required, and in such cases the title will follow the unqualified subject descriptor.

The descriptors selected for use as subject terms are generally the names of specific materials, things, or processes. To the extent possible, a qualifier is selected to describe the properties of, or processses applied to, the subject term.

Index entries are selected to indicate the important ideas and concepts presented in a document, rather than words that may appear in the text. Within the available thesaurus terms, the most probable or logical place to look for typical information is selected. "See references" are included to guide users from synonymous terms or phrases to the descriptor selected as a subject heading for the concept. (e.g. Pipeline Quality Gas see HIGH BTU GAS). "See also references" are used to indicate where to find references to subject concepts that are narrower, broader, or related to a particular subject heading. To complete an exhaustive search of a given subject, all such headings should be reviewed.

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14	1:6756	Dep. NTIS, $4.50
17	1:6681	Dep. NTIS, $5.00
25	1:7330	*See* SAND-75-5742
36	1:6762	Dep. NTIS, $4.00
38	1:6687	Dep. NTIS, $4.50
39	1:6953	Dep. NTIS, $4.50
40	1:6752	*See* DP-MS-75-74
55	1:6710	Dep. NTIS, $4.50
59	1:6397	*See* GA-A-13708
62	1:6365	Dep. NTIS, $5.00
64	1:6773	*See* DP-MS-75-68
65	1:6763	*See* HEDL-SA-956
CONF-751105-		
9	1:7371	Dep. NTIS, $4.50
10	1:7373	*See* DP-MS-75-28
11	1:7372	*See* DP-MS-75-26
12	1:7548	*See* DP-MS-75-29
13	1:7343	*See* DP-MS-75-30
CONF-751107-		
8	1:6400	*See* SRO-525-8
CONF-751108-		
17	1:8039	*See* UCRL-77042
CONF-751109-		
3	1:8095	*See* SAND-75-8742
CONF-751115-		
5	1:7086	*See* DP-MS-75-57
CONF-751116-		
8	1:6750	Dep. NTIS, $4.50
10	1:7211	*See* UCRL-76937
12	1:7019	*See* UCRL-76956
15	1:6769	*See* BNL-20627
16	1:7202	*See* BNL-20628
19	1:7184	*See* LA-UR-75-2181
CONF-751124-		
1	1:6413	*See* SAND-75-6156
CONF-751125-		
48	1:8022	*See* LA-UR-75-2152
49	1:8021	*See* LA-UR-75-2151
50	1:8020	*See* LA-UR-75-2150
67	1:8015	Dep. NTIS, $4.50
70	1:8052	Dep. NTIS, $4.50
71	1:8053	Dep. NTIS, $4.50
72	1:8054	Dep. NTIS, $4.50
73	1:8055	Dep. NTIS, $4.50
74	1:8002	Dep. NTIS, $4.50
75	1:7997	Dep. NTIS, $4.50
76	1:8000	*See* ANL/HEP-CP-75-69
77	1:8001	*See* ANL/HEP-CP-75-70
78	1:8066	*See* UCRL-77214
79	1:8067	*See* UCRL-77219
80	1:8030	*See* LBL-4427
81	1:8046	*See* BNL-20681
82	1:8031	*See* UCRL-77218
83	1:8026	*See* LBL-4431
84	1:8023	*See* LBL-4418
85	1:8025	*See* LBL-4429
86	1:8024	*See* LBL-4425
87	1:8027	*See* BNL-20656
88	1:7990	*See* LA-UR-75-2283
89	1:8003	Dep. NTIS, $3.50
93	1:7980	Dep. NTIS, $3.50
94	1:8004	Dep. NTIS, $3.50
95	1:8005	Dep. NTIS, $4.00
96	1:8006	Dep. NTIS, $3.50
97	1:8007	Dep. NTIS, $3.50
98	1:8016	Dep. NTIS, $3.50
108	1:8012	*See* MATT-1133
109	1:8011	*See* GA-A-13689
110	1:8018	*See* GA-A-13667
111	1:8009	*See* GA-A-13673
112	1:8017	*See* GA-A-13666
113	1:7981	*See* GA-A-13688
114	1:8010	*See* GA-A-13686
CONF-751126-		
3	1:7579	Dep. NTIS, $4.50
5	1:7341	*See* BNWL-SA-5366
CONF-751130-		
4	1:7992	*See* UCRL-77465
5	1:8037	*See* UCRL-77040
6	1:8042	*See* UCRL-77048
7	1:7960	*See* UCRL-77149
8	1:8038	*See* UCRL-77041
9	1:8043	*See* UCRL-77150
10	1:8040	*See* UCRL-77044
11	1:7959	*See* UCRL-77047
12	1:8041	*See* UCRL-77045
13	1:7946	*See* UCRL-77075
16	1:7961	*See* UCRL-77168
17	1:7947	*See* UCRL-77173
CONF-751132-		
1	1:6676	Dep. NTIS, $5.00
2	1:6677	Dep. NTIS, $4.50
CONF-751135-		
1	1:7547	Dep. NTIS, $4.50
CONF-751138-		
1	1:7283	*See* BNWL-SA-5347
CONF-751140-		
1	1:6838	*See* SAND-75-6101
CONF-751141-		
1	1:7208	*See* LA-UR-75-2084
4	1:6828	*See* LA-UR-75-2316
CONF-751142-		
1	1:7651	*See* LA-UR-75-2227
CONF-751143-		
1	1:7601	*See* COO-3017-23
CONF-751144-		
1	1:6926	Dep. NTIS, $4.50
CONF-751145-		
1	1:6371	*See* K-M-6124
CONF-751147-		
1	1:7760	*See* DP-MS-75-95
CONF-751148-		
1	1:7206	Dep. NTIS, $4.50
CONF-751155-		
1	1:7318	*See* UCRL-77520
CONF-751156-		
1	1:7246	*See* UCRL-77558
CONF-751157-		
1	1:6813	Dep. NTIS, $4.50
CONF-751203-		
1	1:6412	*See* SAND-75-6061
2	1:6414	*See* SAND-75-6190
CONF-751205-		
1	1:7900	*See* UCRL-76904
3	1:7571	*See* BNWL-SA-5463
5	1:7580	Dep. NTIS, $4.50
CONF-751209-		
10	1:7122	*See* LA-UR-75-2199
12	1:6941	*See* IS-M-55
13	1:7619	*See* BNL-20626
14	1:7903	*See* BNL-20598
18	1:7806	*See* BNL-20680
19	1:7755	Dep. NTIS, $4.50
20	1:6918	*See* LBL-4105
69	1:6942	*See* IS-M-56
CONF-751210-		
1	1:7225	*See* UCRL-77498
CONF-751211-		
1	1:7407	Dep. NTIS, $5.00
CONF-751212-		
3	1:6938	Dep. NTIS, $4.50
4	1:6939	Dep. NTIS, $4.50
CONF-751215-		
2	1:6353	Dep. NTIS, $4.50
CONF-751218-		
1	1:7070	*See* SAND-75-5942
CONF-751225-		
1	1:7235	Dep. NTIS, $3.50
CONF-760102-		
2	1:7154	*See* SAND-75-8733
CONF-760104-		
2	1:7136	*See* SAND-75-5986
CONF-760202-		
2	1:7317	*See* UCRL-77106
3	1:7303	Dep. NTIS, $4.50

Report No.	Abstract No.	Availibility
4	1:7304	Dep. NTIS, $4.50
5	1:8033	Dep. NTIS, $4.50
7	1:7217	Dep. NTIS, $4.50
8	1:7572	Dep. NTIS, $4.50
9	1:8034	Dep. NTIS, $4.50
10	1:7209	*See* LA-UR-75-2232
11	1:7552	*See* UCRL-77092
12	1:7171	*See* LA-UR-75-2235
13	1:7573	Dep. NTIS, $4.50
14	1:7305	Dep. NTIS, $4.50
15	1:7603	*See* UNI-SA-15
16	1:6768	*See* UNI-SA-14
17	1:7170	*See* LA-UR-75-2205
18	1:7219	*See* UCRL-77532
19	1:7574	Dep. NTIS, $4.50
20	1:7575	Dep. NTIS, $4.50
21	1:7218	*See* UCRL-77198
22	1:7569	*See* LA-UR-75-2272
23	1:7576	*See* LA-UR-75-2253
COO-		
535-733	1:7753	Dep. NTIS, $7.00
881-443	1:7891	Dep. NTIS, $4.00
1407-58	1:7306	Dep. NTIS, $6.00
1545-174	1:7727	Dep. NTIS, $3.50
1674-113	1:7683	Dep. NTIS, $4.50
1676-39	1:6927	Dep. NTIS, $5.00
1748-15	1:7559	Dep. NTIS, $3.50
1764-237	1:7737	Dep. NTIS, $4.50
2130-180	1:7648	Dep. NTIS, $6.50
2174-35	1:7848	Dep. NTIS, $4.50
2204-14	1:6928	Dep. NTIS, $3.50
2229-10	1:7942	Dep. NTIS, $4.50
2245-25	1:6711	Dep. NTIS, $4.00
2250-15	1:6712	Dep. NTIS, $4.50
2250-16	1:6713	Dep. NTIS, $4.50
2262-7	1:6751	Dep. NTIS, $9.75
2428-4	1:7291	Dep. NTIS, $5.50
2444-1	1:7943	Dep. NTIS, $3.50
2493-3	1:8008	Dep. NTIS, $5.00
2532-1	1:7363	Dep. NTIS, $5.00
2562-1	1:7649	Dep. NTIS, $4.50
2564-1	1:6841	Dep. NTIS, $3.50
2689-2	1:7359	Dep. NTIS, $3.50
2692-1	1:6501	Dep. NTIS, $5.50
2736-1	1:7307	Dep. NTIS, $4.50
3010-19	1:7451	Dep. NTIS, $3.50
3017-23	1:7601	Dep. NTIS, $4.50
3069-339	1:7747	Dep. NTIS, $5.00
3069-346	1:7715	Dep. NTIS, $5.00
3069-372	1:7845	Dep. NTIS, $5.00
3077-82	1:8078	Dep. NTIS, $3.50
3129-41	1:7650	Dep. NTIS, $4.50
3140-34	1:7420	Dep. NTIS, $5.00
3150-37	1:6940	Dep. NTIS, $4.50
3151-60	1:6982	Dep. NTIS, $4.50
3246-15	1:7801	Dep. NTIS, $5.50
3268-18	1:7560	Dep. NTIS, $5.00
3333-11	1:7446	Dep. NTIS, $4.50
3409-4	1:6772	Dep. NTIS, $6.00
3533-61	1:7741	Dep. NTIS, $4.00
3565-5	1:7360	Dep. NTIS, $4.00
CREARE-TN-		
224	1:6682	Dep. NTIS, $5.00
CRN-CNPA-		
75-2	1:7236	Dep. NTIS (US Sales Only), $3.50
75-3	1:7237	INIS
DC-		
60-5-24	1:6786	Dep. NTIS, $5.00
DEMO-		
76/1	1:8079	Dep. NTIS (US Sales Only), $3.50
DLCS-		
5000175	1:6683	Dep. NTIS, $4.50
5000275	1:6684	Dep. NTIS, $4.50
5000474	1:6685	Dep. NTIS, $4.50
DP-		
1390	1:6784	Dep. NTIS, $5.50
1395	1:7364	Dep. NTIS, $4.00
DP-MS-		
75-26	1:7372	Dep. NTIS, $4.50
75-28	1:7373	Dep. NTIS, $4.50
75-29	1:7548	Dep. NTIS, $4.50
75-30	1:7343	Dep. NTIS, $4..50
75-57	1:7086	Dep. NTIS, $4.50
75-68	1:6773	Dep. NTIS, $4.50
75-74	1:6752	Dep. NTIS, $4.50
75-95	1:7760	Dep. NTIS, $4.50
DPSPU-		
75-124-1	1:7133	Dep. NTIS, $4.50
DPST-		
75-128-10	1:6422	Dep. NTIS, $4.50
EGG-		
1183-1631	1:7336	Dep. NTIS, $4.00
1183-1632	1:7344	Dep. NTIS, $4.00
ENDF-		
220	1:7824	*See* ORNL-TM-5097
224	1:6724	*See* ORNL-TM-5142
ENSAM-		
74-5	1:7153	INIS
74-5	1:7692	INIS
EPA-		
520/7-75-014	1:7602	U.S. Environmental Protection Agency, Washington, DC
ER-		
7934	1:6508	*See* NSF/RA/N-74-096
ERDA-		
63-75	1:8069	Dep. NTIS, $5.25
64	1:6894	Dep. NTIS, $10.60
69	1:6765	Dep. NTIS, $8.00
103	1:8070	GPO, $3.70
110(Vol.1)	1:7381	Dep. NTIS, $5.45
110(Vol.2)	1:6647	Dep. NTIS, $13.60
110(Vol.4)	1:6648	Dep. NTIS, $10.00
117	1:6480	Dep. NTIS, $4.00
ERDA/JPL-		
954289-75/1	1:6487	Dep. NTIS, $3.50
954328-75/1	1:6488	Dep. NTIS, $3.50
ERDA-tr-		
46	1:6911	Dep. NTIS, $4.50
77	1:8114	Dep. NTIS, $4.50
79	1:7125	Dep. NTIS, $4.50
81	1:6840	Dep. NTIS, $4.50
82	1:6876	Dep. NTIS, $4.50
83	1:6839	Dep. NTIS, $3.50
85	1:7124	Dep. NTIS, $3.50
88	1:7117	Dep. NTIS, $9.75
91	1:7553	Dep. NTIS, $3.50
EUR-		
5309e	1:6814	EUR B.Fr. 1.500
5343e	1:6929	Dep. NTIS (US Sales Only), $5.00
EURFNR-		
1246	1:6736	Dep. NTIS, $6.50
FE-		
496-109	1:6349	Dep. NTIS, $4.00
496-T6	1:6318	Dep. NTIS, $7.60
496-T7	1:6319	Dep. NTIS, $7.60
0479-1	1:6326	Dep. NTIS, $7.60
0479-3	1:6340	Dep. NTIS, $5.45
1207-5	1:6327	Dep. NTIS, $5.45
1224-36	1:6341	Dep. NTIS (US Sales Only), $4.50
1224-37	1:6342	Dep. NTIS, $4.50
1224-44	1:6343	Dep. NTIS, $5.00
1514-42	1:6328	Dep. NTIS, $8.00
1517-22	1:6344	Dep. NTIS, $4.00
1526-2	1:6317	Dep. NTIS, $9.25
1527-5	1:6329	Dep. NTIS, $4.00
1749-3	1:6330	Dep. NTIS, $4.50
1756-1	1:6871	Dep. NTIS, $5.00
1772-3	1:6354	Dep. NTIS, $6.75
1775-1	1:6345	Dep. NTIS, $7.60
1790-1	1:6331	Dep. NTIS, $4.50
1790-2	1:6332	Dep. NTIS, $4.00
2011-1	1:6320	Dep. NTIS, $5.00
2019-1	1:6355	Dep. NTIS, $3.50
2028-1	1:6321	Dep. NTIS, $4.00
2029-1	1:6333	Dep. NTIS, $4.00
2034-1	1:6346	Dep. NTIS, $4.00
FERMILAB-Conf-		
75/76-THY	1:7701	Dep. NTIS, $4.00
75-78-THY	1:7722	Dep. NTIS, $3.50
FIND-		
50338-R1	1:6742	Dep. NTIS, $4.00
50448-R1	1:6743	Dep. NTIS, $4.00
FRNC-TH-		
552	1:7026	INIS
555	1:7015	INIS

Report No.	Abstract No.	Availibility
556	1:7027	INIS
GA-A-		
13175(Suppl.1)	1:6688	Dep. NTIS, $4.00
13278	1:6382	Dep. NTIS, $10.60
13486	1:6689	Dep. NTIS, $5.45
13536	1:7016	Dep. NTIS, $5.45
13539	1:6690	Dep. NTIS, $4.00
13552	1:6383	Dep. NTIS, $4.00
13593	1:6384	Dep. NTIS, $7.60
13602	1:6691	Dep. NTIS, $4.50
13603	1:6692	Dep. NTIS, $5.45
13606	1:6693	Dep. NTIS, $4.00
13616	1:6694	Dep. NTIS, $5.45
13666	1:8017	Dep. NTIS, $3.50
13667	1:8018	Dep. NTIS, $3.50
13671	1:6695	Dep. NTIS, $5.45
13672	1:6817	Dep. NTIS, $5.45
13673	1:8009	Dep. NTIS, $3.50
13677	1:6696	Dep. NTIS, $5.45
13686	1:8010	Dep. NTIS, $3.50
13688	1:7981	Dep. NTIS, $3.50
13689	1:8011	Dep. NTIS, $3.50
13692	1:6697	Dep. NTIS, $4.00
13708	1:6397	Dep. NTIS, $4.50
13742	1:6698	Dep. NTIS, $4.00
GEAP-		
13317—11	1:6818	Dep. NTIS, $6.00
13825-14	1:6714	AT
13923-12	1:6819	AT
14002	1:6774	AT
14031-4	1:6715	AT
14045-3	1:6716	AT
14048	1:6820	AT
14062	1:6966	AT
GEPP-		
172	1:6907	Dep. NTIS, $4.50
GJO-		
1627(Pt.1)	1:6367	Dep. NTIS, $12.75
1627(Pt.2)	1:6368	Dep. NTIS, $7.75
1635-1	1:6369	Dep. NTIS, $7.00
HASL-		
298	1:7292	Dep. NTIS, $8.50
298(App.)	1:7294	Dep. NTIS, $11.00
HEDL-SA-		
764	1:6821	Dep. NTIS, $4.00
766	1:6717	Dep. NTIS, $4.00
795S	1:6718	Dep. NTIS, $3.50
956	1:6763	Dep. NTIS, $4.50
958	1:8056	Dep. NTIS, $4.50
HEDL-TME-		
75-1	1:6719	AT
75-47(Vol.1)	1:6822	Dep. NTIS, $5.45
75-47(Vol.2)	1:6823	Dep. NTIS, $7.60
75-47(Vol.3)	1:6824	Dep. NTIS, $10.00
75-70	1:6825	AT
75-71	1:6720	AT
75-93	1:6775	AT
75-94	1:6721	AT
75-98	1:6776	AT
75-99	1:6777	AT
HW-		
21868	1:7588	Dep. NTIS, $4.50
22076	1:6385	Dep. NTIS, $5.50
44922	1:7009	Dep. NTIS, $4.50
ICP-		
1071	1:6954	Dep. NTIS, $4.00
1074	1:6386	Dep. NTIS, $5.45
1079	1:6996	Dep. NTIS, $7.60
1084	1:6398	Dep. NTIS, $5.45
IEA-		
40A	1:7238	Dep. NTIS (US Sales Only), $4.00
IFA-SR-		
12-1975	1:7421	Dep. NTIS (US Sales Only), $3.50
13-1975	1:7799	Dep. NTIS (US Sales Only), $3.50
IFTJ-		
70/PS	1:6955	Dep. NTIS (US Sales Only), $3.50
72/PS	1:7904	Dep. NTIS (US Sales Only), $3.50
IPP-		
4/132	1:6854	Dep. NTIS (US Sales Only), $5.00

Report No.	Abstract No.	Availibility
IRI-		
133-75-08	1:7424	Dep. NTIS (US Sales Only), $3.50
IS-		
3339	1:8080	Dep. NTIS, $5.00
3773	1:8081	Dep. NTIS, $4.00
IS-M-		
49	1:6968	Dep. NTIS, $4.50
50	1:6969	Dep. NTIS, $4.50
55	1:6941	Dep. NTIS, $4.50
56	1:6942	Dep. NTIS, $4.50
IS-T-		
688	1:7028	Dep. NTIS, $8.75
704	1:7044	Dep. NTIS, $8.75
ITP-		
75-25R	1:6990	Dep. NTIS (US Sales Only), $4.00
JINR-		
11-7943	1:7239	INIS
P9-9139	1:7180	Dep. NTIS (US Sales Only), $4.50
P11-9112	1:7956	Dep. NTIS (US Sales Only), $4.50
P11-9113	1:7933	Dep. NTIS (US Sales Only), $4.50
P11-9222	1:8082	Dep. NTIS (US Sales Only), $3.50
JPL-		
4	1:6420	Dep. NTIS, $5.50
JUL-		
1004-MA	1:8083	Dep. NTIS (US Sales Only), $6.00
1013-WT	1:8112	Dep. NTIS (US Sales Only), $5.50
K-M-		
6124	1:6371	Dep. NTIS, $4.50
KAPL-P-		
4040	1:7017	Dep. NTIS, $4.50
KD-		
3266(Rev.)	1:7326	Dep. NTIS, $3.50
KFK-		
1749	1:8084	Dep. NTIS (US Sales Only), $6.00
2204	1:8085	Dep. NTIS (US Sales Only), $7.75
KFK-PDV-		
47	1:8086	Dep. NTIS (US Sales Only), $4.50
53	1:8087	Dep. NTIS (US Sales Only), $6.75
KFKI-		
75-56	1:8088	Dep. NTIS (US Sales Only), $5.50
LA-		
3067-MS(Rev.)	1:7130	Dep. NTIS, $5.50
6014	1:7277	Dep. NTIS, $4.00
6016-SOP	1:6778	Dep. NTIS, $4.00
6028	1:6722	Dep. NTIS, $4.00
6044-PR	1:7982	Dep. NTIS, $7.60
6051	1:8057	Dep. NTIS, $4.50
6073-MS	1:7635	Dep. NTIS, $4.00
6074-PR	1:7128	Dep. NTIS, $4.00
6097-MS	1:7258	Dep. NTIS, $4.50
6105-MS	1:7756	Dep. NTIS, $4.00
6106-MS	1:6826	Dep. NTIS, $4.00
6113-MS	1:6746	Dep. NTIS, $4.00
6118-MS	1:8058	Dep. NTIS, $4.00
6120-PR	1:7159	Dep. NTIS, $4.00
6121-MS	1:7207	Dep. NTIS, $4.50
6124-MS	1:7137	Dep. NTIS, $4.00
6127-MS	1:6827	Dep. NTIS, $4.00
6135-MS	1:7107	Dep. NTIS, $4.00
6144-PR	1:7408	Dep. NTIS, $4.00
6149-MS	1:7604	Dep. NTIS, $4.00
6154-MS	1:7272	Dep. NTIS, $4.50
6156-PR	1:7169	Dep. NTIS, $5.45
6157-MS	1:6699	Dep. NTIS, $4.00
6170-MS	1:6645	Dep. NTIS, $4.50
6173-MS	1:7988	Dep. NTIS, $4.50
6178-MS	1:7989	Dep. NTIS, $4.50
LA-tr-		
75-40	1:7049	Dep. NTIS, $4.50
75-41	1:7048	Dep. NTIS, $5.00
75-42	1:7143	Dep. NTIS, $3.50
75-45	1:6989	Dep. NTIS, $3.50

Report No.	Abstract No.	Availibility
LA-UR-		
75-2084	1:7208	Dep. NTIS, $4.50
75-2150	1:8020	Dep. NTIS, $4.50
75-2151	1:8021	Dep. NTIS, $4.50
75-2152	1:8022	Dep. NTIS, $4.50
75-2157	1:8059	Dep. NTIS, $4.50
75-2181	1:7184	Dep. NTIS, $3.50
75-2199	1:7122	Dep. NTIS, $4.50
75-2205	1:7170	Dep. NTIS, $4.50
75-2227	1:7651	Dep. NTIS, $4.50
75-2232	1:7209	Dep. NTIS, $4.50
75-2235	1:7171	Dep. NTIS, $4.50
75-2253	1:7576	Dep. NTIS, $3.50
75-2259	1:7549	Dep. NTIS, $3.50
75-2272	1:7569	Dep. NTIS, $3.50
75-2283	1:7990	Dep. NTIS, $3.50
75-2316	1:6828	Dep. NTIS, $3.50
LBL-		
3283	1:6891	Dep. NTIS, $5.00
3401	1:7621	Dep. NTIS, $4.50
3699	1:8113	Dep. NTIS, $5.50
3712	1:7030	Dep. NTIS, $5.00
3849	1:7761	Dep. NTIS, $6.50
3868	1:7098	Dep. NTIS, $7.60
3876	1:7622	Dep. NTIS, $4.50
4105	1:6918	Dep. NTIS, $3.50
4109	1:6943	Dep. NTIS, $5.50
4170	1:7905	Dep. NTIS, $5.00
4178	1:7906	Dep. NTIS, $4.50
4188	1:7606	Dep. NTIS, $6.75
4239	1:6495	Dep. NTIS, $6.25
4240	1:8089	Dep. NTIS, $7.75
4249	1:7716	Dep. NTIS, $5.50
4250	1:7561	Dep. NTIS, $4.00
4255	1:7226	Dep. NTIS, $5.00
4291	1:7657	Dep. NTIS, $4.50
4418	1:8023	Dep. NTIS, $4.50
4425	1:8024	Dep. NTIS, $4.50
4427	1:8030	Dep. NTIS, $4.50
4429	1:8025	Dep. NTIS, $4.50
4431	1:8026	Dep. NTIS, $4.50
4433	1:7201	Dep. NTIS, $6.50
4530	1:7063	Dep. NTIS, $8.50
4608	1:7636	Dep. NTIS, $4.50
4609	1:7064	Dep. NTIS, $4.50
4610	1:7717	Dep. NTIS, $6.00
LF-tr-		
101	1:7453	Dep. NTIS, $3.50
102	1:7411	Dep. NTIS, $3.50
104	1:8071	Dep. NTIS, $3.50
LTSS-		
209(Ed.1)(Pt.3)	1:8090	Dep. NTIS, $8.50
MATT-		
1133	1:8012	Dep. NTIS, $4.00
1165	1:8060	Dep. NTIS, $4.00
1177	1:7957	Dep. NTIS, $4.00
1182	1:7970	Dep. NTIS, $4.00
MCR-		
75-9	1:6496	*See* PB-239185
MERC/RI-		
75/2	1:6334	Dep. NTIS, $3.50
75/3	1:6322	Dep. NTIS, $4.00
MHSMP-		
75-5J	1:7259	Dep. NTIS, $3.50
75-40	1:7260	Dep. NTIS, $3.50
75-40A	1:7261	Dep. NTIS, $3.50
75-40B	1:7262	Dep. NTIS, $3.50
75-40H	1:7263	Dep. NTIS, $3.50
75-40J	1:7264	Dep. NTIS, $3.50
75-40L	1:7265	Dep. NTIS, $3.50
75-40M	1:7266	Dep. NTIS, $3.50
MLM-		
2192	1:6991	Dep. NTIS, $4.00
2241	1:6995	Dep. NTIS, $5.45
2259	1:8035	Dep. NTIS, $4.00
2274	1:7241	Dep. NTIS, $4.00
2278	1:7242	Dep. NTIS, $4.00
N-		
75-17083	1:7581	NTIS, $3.75
75-22937	1:7365	NTIS, $3.25
NASA-CR-		
141607	1:7581	*See* N-75-17083
NASA-TM-X-		
72723	1:7365	*See* N-75-22937

Report No.	Abstract No.	Availibility
NERC-LV-		
539-10	1:7314	Dep. NTIS, $5.45
NP-		
20624	1:7322	Tennessee Valley Authority, Chattanooga, TN
20730	1:6860	Dep. NTIS (US Sales Only), $9.00
NSF-		
75-72-GI-39456	1:6601	*See* PB-242935
NSF/RA/G-		
74-018	1:6525	*See* PB-240553
74-028	1:6526	*See* PB-240784
74/029	1:6531	*See* PB-243548
75/005	1:6532	*See* PB-243549
75/006	1:6533	*See* PB-243550
NSF/RA/N-		
74-047	1:6490	*See* PB-239512
74-067	1:6523	*See* PB-238683
74-096	1:6508	GPO, $3.05
74-152(5)	1:6491	*See* PB-239760
74/186	1:6534	*See* PB-244151
75-002	1:6496	*See* PB-239185
75-016	1:6492	*See* PB-241054
75-024	1:6600	*See* PB-242258
75-026	1:6504	*See* PB-242155
75078	1:6522	NTIS
NSF/RANN/SE/AG-		
550/FR75/2	1:6559	*See* UCID-3739
NVO-		
168	1:7278	*See* PNE-RB-73
269-26	1:7374	Dep. NTIS, $4.50
1163-77	1:7273	Dep. NTIS, $4.00
NWC-TP-		
5676	1:6463	*See* AD/A-000100
OCR-		
66-INT4	1:6340	*See* FE-0479-3
ORNL-		
4888	1:7550	Dep. NTIS, $5.45
5048	1:6906	AT
5059	1:6678	Dep. NTIS, $7.60
5065	1:7156	Dep. NTIS, $6.50
5072	1:7562	Dep. NTIS, $7.60
5083	1:6829	Dep. NTIS, $7.60
5086	1:6930	Dep. NTIS, $4.00
5090	1:6387	Dep. NTIS, $5.45
5093	1:6347	Dep. NTIS, $6.00
5094	1:6723	AT
5099	1:7157	AT
5109	1:6370	Dep. NTIS, $6.50
ORNL-TM-		
4333(Pt.1)	1:6404	Dep. NTIS, $4.50
4747	1:6388	Dep. NTIS, $5.50
4905	1:7134	Dep. NTIS, $7.60
4947	1:6389	Dep. NTIS, $8.50
4984	1:6830	AT
5028	1:6931	AT
5059	1:6390	Dep. NTIS, $5.50
5070(Rev.)	1:6747	Dep. NTIS, $5.00
5071	1:7945	Dep. NTIS, $4.00
5075	1:6831	Dep. NTIS, $4.00
5077	1:6399	Dep. NTIS, $5.00
5083	1:7210	Dep. NTIS, $6.00
5090	1:6679	Dep. NTIS, $5.45
5096	1:6391	Dep. NTIS, $5.00
5097	1:7824	Dep. NTIS, $5.50
5109	1:7991	Dep. NTIS, $7.60
5111	1:6779	Dep. NTIS, $4.00
5113	1:7131	Dep. NTIS, $5.00
5139	1:7551	Dep. NTIS, $5.00
5140	1:6832	Dep. NTIS, $5.50
5142	1:6724	AT
5144	1:6833	Dep. NTIS, $5.00
5169	1:6780	Dep. NTIS, $4.00
5173	1:6725	AT
5174	1:7866	Dep. NTIS, $5.45
5183	1:6781	AT
5187	1:7123	Dep. NTIS, $5.00
5192	1:6932	AT
5199	1:8091	Dep. NTIS, $5.50
5205	1:6834	Dep. NTIS, $4.50
5214	1:6316	Dep. NTIS, $5.00
5217	1:6835	Dep. NTIS, $5.00
5225	1:6782	Dep. NTIS, $5.50
5233	1:8061	Dep. NTIS, $7.75

Report No.	Abstract No.	Availibility
ORNL-tr-		
2956	1:7072	Dep. NTIS, $4.50
2996	1:7118	Dep. NTIS, $4.25
4027	1:7938	Dep. NTIS, $4.50
4030	1:7971	Dep. NTIS, $4.50
4037	1:7067	Dep. NTIS, $4.50
4044	1:7333	Dep. NTIS, $4.50
4046	1:6919	Dep. NTIS, $4.50
4047	1:7949	Dep. NTIS, $4.50
4058	1:6551	Dep. NTIS, $4.50
4064	1:7175	Dep. NTIS, $5.00
4065	1:7177	Dep. NTIS4.50
4068	1:7327	Dep. NTIS, $3.50
4072	1:7247	Dep. NTIS, $3.50
ORO-		
748	1:7328	Dep. NTIS, $5.50
2583-15	1:7543	Dep. NTIS, $4.50
2591-75	1:7611	Dep. NTIS, $6.00
3956-3	1:7702	Dep. NTIS, $3.50
4066-7	1:7345	Dep. NTIS, $6.50
4205-1	1:7010	Dep. NTIS, $8.50
4213-2	1:7075	Dep. NTIS, $7.50
4447-031	1:7094	Dep. NTIS, $4.00
4699-2	1:7763	Dep. NTIS, $5.00
4700-2	1:7346	Dep. NTIS, $4.50
4856-3	1:7880	Dep. NTIS, $5.00
4856-37	1:7911	Dep. NTIS, $4.00
4856-41	1:7758	Dep. NTIS, $3.50
4881-3	1:7658	Dep. NTIS, $4.50
4918-4	1:6502	Dep. NTIS, $3.50
4918-6	1:6503	Dep. NTIS, $3.50
PATENTS-DK-		
129,882	1:7213	
PATENTS-US-		
A548,058	1:6406	
A550,099	1:7011	
3,892,625	1:6737	
3,892,970	1:7172	
3,893,939	1:7014	
3,894,554	1:6738	
3,894,912	1:6753	
3,895,935	1:6912	
3,895,939	1:6913	
3,896,042	1:7024	
3,896,306	1:7222	
3,896,392	1:7173	
3,898,309	1:6377	
3,898,431	1:6757	
3,898,456	1:7214	
3,898,496	1:7179	
3,898,586	1:7146	
3,901,409	1:7121	
3,901,786	1:7100	
3,902,000	1:6671	
3,902,038	1:6914	
3,902,369	1:6739	
3,904,273	1:7149	
3,904,500	1:7050	
3,904,815	1:7127	
3,904,985	1:7148	
3,905,243	1:6740	
3,905,634	1:6764	
3,908,123	1:6417	
3,909,292	1:6850	
3,909,293	1:6849	
3,909,294	1:6844	
3,909,297	1:6845	
3,909,298	1:6851	
3,909,300	1:6848	
3,909,370	1:6378	
3,909,617	1:6423	
3,912,536	1:6852	
3,913,315	1:6668	
3,919,002	1:6916	
3,919,003	1:6915	
3,919,004	1:6917	
A266,092(70)	1:6842	
PB-		
219368	1:6911	*See* ERDA-tr-46
236406	1:6361	NTIS, $3.75
238094	1:7284	NTIS, $7.00
238294	1:7285	NTIS, $3.75
238668	1:6359	Geophys. Res. Lett.; 1: No. 5, 213-216(Sep 1974)
238683	1:6523	NTIS, $8.50
238965	1:7377	NTIS, $3.75
239185	1:6496	NTIS, $11.50
239194	1:7599	NTIS, $5.25
239227	1:7378	NTIS, $3.25
239347	1:7597	NTIS, $5.75
239512	1:6490	NTIS, $5.25
239670	1:7598	NTIS, $4.75
239760	1:6491	NTIS, $5.25
239941	1:6524	NTIS, $4.25
240553	1:6525	NTIS, $3.75
240784	1:6526	NTIS, $5.25
241054	1:6492	NTIS, $4.25
242155	1:6504	NTIS, $5.75
242258	1:6600	NTIS, $5.25
242727	1:6527	NTIS, $4.75
242728	1:6528	NTIS, $4.25
242729	1:6529	NTIS, $4.25
242935	1:6601	NTIS, $3.25
243117	1:6530	NTIS, $5.25
243548	1:6531	NTIS, $5.25
243549	1:6532	NTIS, $3.75
243550	1:6533	NTIS, $5.25
244151	1:6534	NTIS, $4.25
PEM-		
22	1:7228	Dep. NTIS, $4.50
39	1:7229	Dep. NTIS, $5.00
PERC-		
0055-1	1:7108	Dep. NTIS, $3.50
PERC/RI-		
75/6	1:6335	Dep. NTIS, $5.45
PERC/TPR-		
75/2	1:6338	Dep. NTIS, $4.50
PNE-MHF-		
3	1:6363	Dep. NTIS, $10.00
PNE-RB-		
63(Add.)	1:7315	Dep. NTIS, $5.00
73	1:7278	Dep. NTIS, $4.50
PNE-WW-		
40	1:7353	Dep. NTIS, $5.00
PRNC-		
190	1:7361	Dep. NTIS, $6.00
195	1:7329	Dep. NTIS, $5.00
PRWG-		
105-3	1:7599	*See* PB-239194
R-		
74-9	1:7284	*See* PB-238094
RADC-TR-		
75-90	1:6505	*See* AD/A-008789
RDT-F-		
11-5T(5-75)	1:6375	RSO
RDT-M-		
4-5T(10-75)	1:6908	RSO
RFP-		
2351	1:6956	Dep. NTIS, $4.00
RFP-Trans-		
168	1:7066	Dep. NTIS, $4.50
171	1:6975	Dep. NTIS, $4.50
173	1:7035	Dep. NTIS, $4.50
174	1:6946	Dep. NTIS, $4.50
176	1:7036	Dep. NTIS, $4.25
RISO-		
309	1:8092	Dep. NTIS (US Sales Only), $6.00
RISO-M-		
1594(Ed.2)	1:8093	Dep. NTIS (US Sales Only), $4.50
RLO-		
1388-294	1:7867	Dep. NTIS, $4.50
1388-296	1:6766	Dep. NTIS, $6.50
RR-SMT/R-		
7403	1:6360	*See* AERE-R-8067
SAND-		
74-0090	1:7109	Dep. NTIS, $3.50
75-0062	1:7135	Dep. NTIS, $4.00
75-0314	1:7267	Dep. NTIS, $4.50
75-0412	1:7110	Dep. NTIS, $5.45
75-0421	1:7111	Dep. NTIS, $4.50
75-0424	1:8094	Dep. NTIS, $5.50
75-0444	1:7112	Dep. NTIS, $3.50
75-0494	1:7600	Dep. NTIS, $4.50
75-0536	1:6846	Dep. NTIS, $4.50
75-0551	1:6493	Dep. NTIS, $5.00
75-0556	1:6726	Dep. NTIS, $4.00
75-0632	1:6836	Dep. NTIS, $6.00
75-0651	1:6348	Dep. NTIS, $5.50

Report No.	Abstract No.	Availibility
75-0653	1:6837	Dep. NTIS, $6.00
75-0669	1:6336	Dep. NTIS, $4.00
75-5443	1:8062	Dep. NTIS, $3.50
75-5519	1:6970	Dep. NTIS, $4.00
75-5656	1:6405	Dep. NTIS, $4.00
75-5742	1:7330	Dep. NTIS, $4.50
75-5869	1:7366	Dep. NTIS, $4.75
75-5942	1:7070	Dep. NTIS, $4.50
75-5986	1:7136	Dep. NTIS, $4.50
75-6061	1:6412	Dep. NTIS, $4.50
75-6101	1:6838	Dep. NTIS, $4.50
75-6156	1:6413	Dep. NTIS, $4.00
75-6190	1:6414	Dep. NTIS, $4.50
75-8055	1:7113	Dep. NTIS, $5.00
75-8222	1:6994	Dep. NTIS, $3.50
75-8733	1:7154	Dep. NTIS, $4.50
75-8740	1:6992	Dep. NTIS, $5.00
75-8742	1:8095	Dep. NTIS, $4.50
SC-DR-		
72-0197	1:7268	Dep. NTIS, $4.00
SLAC-		
186	1:8096	Dep. NTIS, $3.75
SLAC-Trans-		
170	1:7893	Dep. NTIS, $4.00
SM-		
193/51	1:7216	*See* CONF-750331-2
199/47	1:7371	*See* CONF-751105-9
199/81	1:7372	*See* DP-MS-75-26
199/83	1:7548	*See* DP-MS-75-29
199/84	1:7373	*See* DP-MS-75-28
199/85	1:7343	*See* DP-MS-75-30
SR-		
6/23	1:7580	*See* CONF-751205-5
SRO-		
525-8	1:6400	Dep. NTIS, $4.75
757-5	1:7379	Dep. NTIS, $4.50
STAN-CS-		
75-513	1:8096	*See* SLAC-186
STI/PUB-		
402	1:7114	IAEA, $41.00
SU-		
326P.39-6	1:7162	*See* SU-SEL-75-049
4206-61	1:7741	*See* COO-3533-61
SU-SEL-		
75-049	1:7162	Dep. NTIS, $4.00
TEC-		
75/001	1:6900	Dep. NTIS, $5.45
75/002	1:6901	Dep. NTIS, $5.45
75/003	1:6902	Dep. NTIS, $5.45
75-006a	1:6896	Dep. NTIS, $5.45
TID-		
3317(Suppl.6)	1:7854	Dep. NTIS, $7.60
26608	1:7295	Dep. NTIS, $6.00
26882	1:7269	Dep. NTIS, $5.50
26914	1:6535	Dep. NTIS, $5.00
26936	1:7449	Dep. NTIS, $4.50
26937	1:8013	Dep. NTIS, $7.75
27915	1:6407	Washington, DC; National Academy of Sciences (1975). $8.50
TR-		
75-029.1	1:7138	*See* UCRL-13660
TT-		
74-58063	1:6494	NTIS, $5.75
74-58066	1:6550	NTIS, $5.25
UCCND-CSD-		
2	1:8097	Dep. NTIS, $5.45
3	1:8098	Dep. NTIS, $5.45
4	1:8099	Dep. NTIS, $5.45
UCCND-CSD-INF-		
74	1:8100	Dep. NTIS, $5.00
UCID-		
3707(Rev.)	1:6867	Dep. NTIS, $3.50
3739	1:6559	Dep. NTIS, $4.50
15644-75-2	1:6997	Dep. NTIS, $5.25
16913	1:8101	Dep. NTIS, $5.45
16927	1:7296	Dep. NTIS, $4.50
16933	1:7025	Dep. NTIS, $7.60
16949-75-3	1:7129	Dep. NTIS, $4.00
16956	1:6944	Dep. NTIS, $4.50
16966	1:7005	Dep. NTIS, $4.50
16968	1:6356	Dep. NTIS, $4.00
16969	1:7274	Dep. NTIS, $5.00
16973	1:7958	Dep. NTIS, $5.00
16978	1:8063	Dep. NTIS, $4.00
16979	1:8064	Dep. NTIS, $4.00
16980	1:8065	Dep. NTIS, $4.00
16981	1:7863	Dep. NTIS, $4.50
30123	1:8102	Dep. NTIS, $4.00
30125	1:8103	Dep. NTIS, $5.45
UCLA-		
10-P25-33	1:7695	Dep. NTIS, $3.50
12-1040	1:7065	Dep. NTIS, $5.00
UCRL-		
13660	1:7138	Dep. NTIS, $5.50
13668	1:7115	Dep. NTIS, $4.50
50025-75-4	1:8068	Dep. NTIS, $4.00
50028-75-3	1:7033	Dep. NTIS, $5.45
50031-75	1:8014	Dep. NTIS, $5.45
51244(Rev.1)	1:6945	Dep. NTIS, $4.00
51444-75	1:7286	Dep. NTIS, $5.00
51719(Rev.1)	1:7270	Dep. NTIS, $5.45
51886	1:7316	Dep. NTIS, $3.50
51900	1:8104	Dep. NTIS, $4.00
51919	1:6364	Dep. NTIS, $4.00
51920(Vol.1)	1:7297	Dep. NTIS, $7.60
51921	1:8036	Dep. NTIS, $4.00
51928	1:6376	Dep. NTIS, $5.45
51931	1:7139	Dep. NTIS, $9.75
51936	1:7230	Dep. NTIS, $4.00
51948	1:7354	Dep. NTIS, $4.00
51964	1:7006	Dep. NTIS, $4.00
76198	1:7298	Dep. NTIS, $4.50
76603	1:6478	Dep. NTIS, $5.00
76887	1:7271	Dep. NTIS, $4.00
76904	1:7900	Dep. NTIS, $4.00
76937	1:7211	Dep. NTIS, $4.50
76956	1:7019	Dep. NTIS, $4.50
77040	1:8037	Dep. NTIS, $5.00
77041	1:8038	Dep. NTIS, $4.50
77042	1:8039	Dep. NTIS, $5.50
77044	1:8040	Dep. NTIS, $4.50
77045	1:8041	Dep. NTIS, $4.50
77047	1:7959	Dep. NTIS, $4.50
77048	1:8042	Dep. NTIS, $4.50
77075	1:7946	Dep. NTIS, $5.00
77092	1:7552	Dep. NTIS, $4.50
77106	1:7317	Dep. NTIS, $4.50
77149	1:7960	Dep. NTIS, $4.50
77150	1:8043	Dep. NTIS, $4.50
77168	1:7961	Dep. NTIS, $3.50
77173	1:7947	Dep. NTIS, $3.50
77198	1:7218	Dep. NTIS, $4.50
77214	1:8066	Dep. NTIS, $4.50
77218	1:8031	Dep. NTIS, $4.50
77219	1:8067	Dep. NTIS, $4.50
77310	1:7612	Dep. NTIS, $4.50
77311	1:7659	Dep. NTIS, $4.50
77458	1:7409	Dep. NTIS, $4.00
77465	1:7992	Dep. NTIS, $4.50
77498	1:7225	Dep. NTIS, $4.50
77520	1:7318	Dep. NTIS, $4.50
77532	1:7219	Dep. NTIS, $4.50
77558	1:7246	Dep. NTIS, $4.50
77561	1:7140	Dep. NTIS, $4.50
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Information regarding subscription purchase will be sent on request.
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Dep. — ERDA reports so designated are maintained in the organizations listed on the inside front cover.

EM — Inquiries regarding the availability of blueline prints of ERDA engineering drawings which were formerly available for sale by NTIS should be addressed to USERDA, Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

GJO — Available from USERDA, Grand Junction Office, P. O. Box 2567, Grand Junction, Colorado 81501.

GPO — For sale by the Superintendent of Documents, Government Printing Office, Washington, D. C. 20402.

LMEC — Available *only to requesters within the United States* from the Liquid Metal Engineering Center, P. O. Box 1449, Canoga Park, CA 91304.

NTIS — For sale by the National Technical Information Service (NTIS), U. S. Department of Commerce, Springfield, Virginia 22161. Price given is the domestic price for paper copy; foreign purchasers add $2.50 per report copy.

RSO — Available *only to requesters within the United States* from the Reactor Standards Office, Oak Ridge National Laboratory, P. O. Box X, Oak Ridge, TN 37830.

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